The Impediments to the Adoption of the Design and Build Project Procurement Strategy in the Saudi Construction Industry

By

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In the fast moving world with open international markets, the timely completion of construction projects within a stipulated budget will be of the highest priority. It can take months, years, and even decades to plan, design, procure, construct and handover a project to the client. Delays can mean failure. Similar to other parts of the world, the Saudi construction industry is being increasingly challenged to provide for faster, more economical and better construction. Clients are looking for new innovative methods that will shorten the project duration, meet the established budget and achieve the desired quality level. Design and Build (D&B) project procurement strategy appears to present a viable option. Whilst the benefits of D&B contracting have been directly realized in many industries for procuring various projects in many parts of the world, the Saudi construction industry has been slow to accept the D&B option. The D&B project delivery option has not been adopted on a grand scale and its application is still limited. The traditional design, bid, build (D.B.B) project delivery option still dominates the local Saudi construction industry.

On a close examination, there appears to be impediments preventing the adoption of D&B contracting within the Saudi construction industry. This study will investigate and define these impediments and propose practical recommendations to overcome them. To investigate this problem and discover these practical solutions, a mixed methodology approach is employed. Both quantitative and qualitative data from surveys and direct interviews have been gathered. The interviews were conducted with key participants representing consulting and contracting firms, manufacturers, developers, public and private sector clients, financial market evaluators, and insurance firms. To enrich the investigation, a pertinent case study for a university campus which was procured along the D&B option is also examined. The main findings are reported with a set of recommendation. The results suggest that local industry stakeholders are divided or undecided on the benefits of D&B and its appropriateness. The nature of these impediments are cultural, lack of knowledge about D&B option, a scarcity of medium size D&B firms, and current government contracts which are based on the traditional D.B.B delivery option.

Recommendations to improve the performance and productivity utilizing D&B are presented including a practical guidelines model to be consulted by D&B clients.

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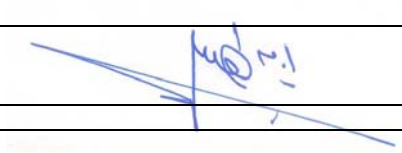
Signature of Candidate*:*		Date:	February, 06, 2011

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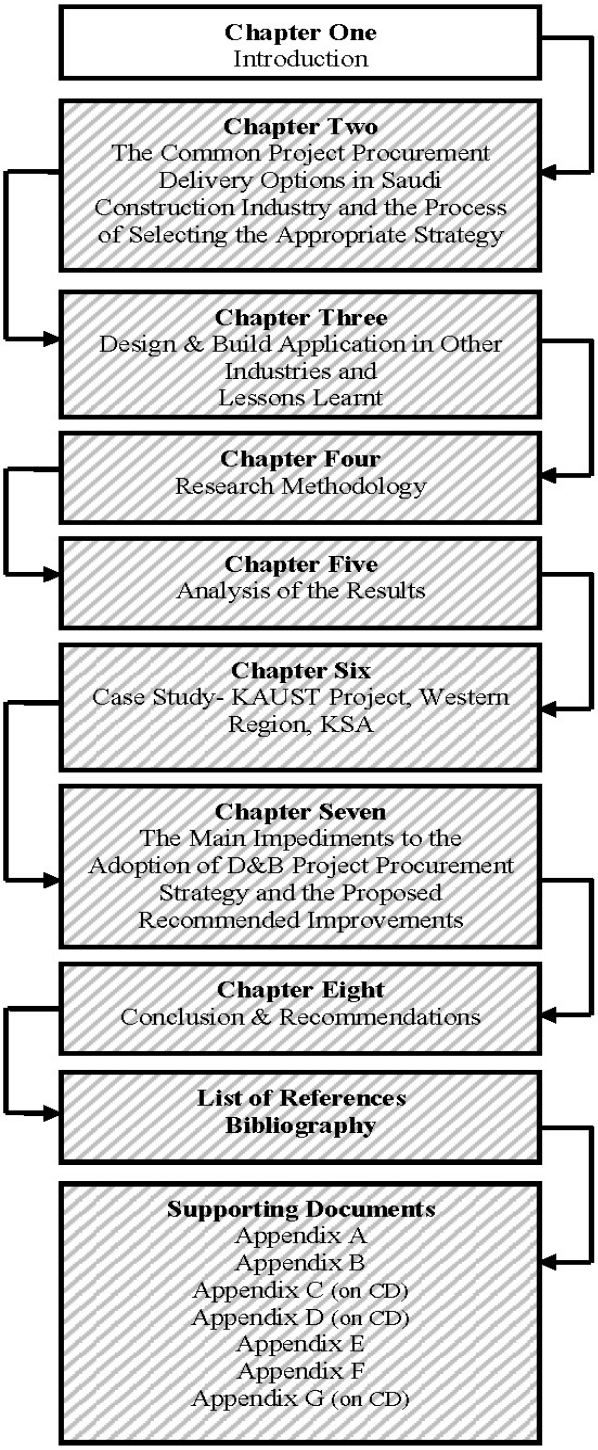
Glossary

• Arriyadh Development Authority	ADA
• Billion	bn
• Bills of Quantities	BOQ
• Concurrent Engineering	CE
• Critical Path Method	CPM
• Construction Management	CM
• Design Bid Build	D.B.B
• Design & Build	D&B
• Design And Build Institute of America	DBIA
• Design For Manufacturing	DFM
• Design For Assembly	DFA
• Facilities Management	FM
• Guaranteed Maximum Price	GMP
• Headquarter Building	HQ
• Hellmuth, Obata,+ Kassabaum, Inc	HOK
• Information Technology	IT
• Issued For Construction	IFC
• King Abdullah University Of Science & Technology	KAUST
• Million	m
• Nominated Sub-Contractor	NS
• National Economic Development Office	NEDO
• Project Design Process	PDP
• Project Life-Cycle	PLC
• Project Manager	PM
• Project Sponsor	PS
• Public Private Partnership	PPP
• Quality Assurance	QA
• Quality Control	QC
• Quantity Surveyor	QS
• Request for Proposal	RFP
• Research & Development	R/D
• Risk Management	RM
• Royal Institute of British Architects	RIBA
• Saudi Oger Limited	SOL
• Saudi Arabian Oil Company	SAUDI ARAMCO
• The American Institute of Architecture	AIA
• Thinking About Buildings	TAB
• United States of America	USA
• Value and Risk Management	VRM
• Value Management	VM

Chapter I
Introduction.



1.1 Introduction

The construction industry considers projects successful if they are delivered on time or sooner, on budget, and achieve a specified quality standard, while meeting or exceeding the client's expectations. All clients wish to have a design that is efficient, flexible, and absent of unnecessary spaces and cost overruns. Experience tells us that in reality this is unattainable. Clients have to trade off time, cost and quality objectives when considering a wide array of project related contractual and commercial matters. Conflicting deadlines, and resource restrictions and constraints continually increase pressure on the construction industry to improve its efficiency.

The growing need to improve performance is now leading to the discovery of innovative ways to plan, design, and manage projects, including the procurement process. This will be accomplished through effective research seeking ways to accelerating the process, building faster, controlling delays and achieving much higher productivity. Time based performance improvement is considered as the way to solve industry's problems including delays, cost overruns, low profitability, and lack of innovation.

The Saudi construction industry which is going through a major construction boom is affected and influenced by international construction industry activities and changes. Forbes Arabia (March 2005) reported that published committed spending by the public sector for the next decade is expected to exceed $495 billion US Dollars. Oxford Business Group (Dec. 2009), Saudi Arabia report, estimated that the spending on construction projects in 2009 and 2010 will reach $185billion. The Middle East Economic Digest, MEED, (Jan. 2005) reported that there are shortages of engineers, contractors, consultants and skilled labour to handle the massive construction boom in the Kingdom of Saudi Arabia. Numerous international consulting and construction firms are operating in the Kingdom and many Saudi projects are tendered internationally. The current construction boom, inflation, cost of capital, and delays have influenced the decisions of many clients to seek quicker methods of procurement. The dominance of the traditional Design-Bid-Build (D-B-B) procurement system is a major factor that several Saudi researchers have argued is an impediment to improving performance and productivity within the Saudi construction industry. AIA (2003) showed that there is evidence in the United States that indicates a spread to other procurement methods occurred in the 1980's. The 'traditional route' where the building is fully designed, and the contract administered

by an architect was losing favour. During the past three decades, according to (Sell, 2003, Ling and Liu 2004) the use and interest in Design and Build (D&B) contracting in the USA and UK has greatly accelerated, becoming one of the most significant trends in the design and construction industry. D&B has gained attention, because owners, and government agencies, found it attractive for complex projects. It reduced project time, eliminated major gaps in building a project.

The winds of change are in the local construction market. Recently, more attention has been directed towards earlier start of site construction activities. Design and Build (D&B) project procurement strategy appears to offer an obvious solution. However, D&B option is still not widely accepted as a valid and credible method for procuring projects, (Al Kharashi and Skitmore 2009, Jaweed 2004, Al Khalil and Ghafry 1999). The phenomenal regional construction boom and the demand for quicker completion of projects are challenges to the local construction industry. It is confronted with a shortage of skilled labour and professionals. In an attempt to draw attention to the problem of the sluggish movement and development of the Saudi construction industry, the Saudi Chamber of Commerce and Industry Council organized an international real-estate and property conference in March 2007. This conference was sponsored by the Saudi Crown Prince and five cabinet ministers. It was aimed at achieving five significant objectives:

1. Draw the public's attention to the fact that the construction industry is a significant contributor to the national economy, just behind the oil and gas sector. Statistically, this sector is worth about SR 800 billion Saudi Riyals.
2. Highlight the need to overcome the construction industry's problems of low productivity.
3 Raise the public's awareness of the need to supply the local market with 800,000 residences each year, for the next five years, with the urban amenities, in a market where less than 70% of Saudis do not own their houses.
4 Investigate and develop the means of providing Islamic financial funding schemes to facilitate borrowing from financial institutions.
5 Engage the local universities in devising new programs to develop construction academic programs to deliver projects within the shortest possible time.

This research explores why the D&B delivery method is not widely adopted for the Saudi construction industry. It investigates the industry stakeholders' perception views and opinions in order to define the impediments to adopting this project delivery option. Solutions are provided that will increase the awareness of the industry's stakeholders regarding D&B project procurement option and encourage its use. It reviews the applicable project procurement systems practiced in the Saudi construction industry in general and the historical application of the D&B option.

1.2 Justification for this Research

This study addresses a relevant problem worthy of research for two reasons.

Firstly, there is a need to resolve the slow adoption and development of the D&B project delivery system by Saudi construction industry. This can be achieved by drawing the industry's attention to the inherent benefits of the D&B option which the international construction industry has been using for decades.

Secondly, D&B option offers efficiency, cost saving, innovation in design and rapid completion of projects when properly applied. The local industry stakeholders have had little exposure to project delivery options other than the D.B.B. This may partly explain the unpopularity of D&B contracting. This study will encourage them to discover a more efficient way to procure and deliver construction work using D&B. This research problem was identified as a result of several informal interviews, hearing concerns at Saudi Engineering Council meetings, and from discussing this issue with many fellow professionals. The author was motivated by the amount of encouragement received, willingness and support to provide access to relevant data and materials from many colleagues at consulting offices, contracting firms and local authorities. The author had worked with many of these professionals since 1985.

The review of the literature revealed that several groups of Saudi researchers have studied this problem from different perspectives. Al Mansouri (1988) compared the salient features of the Saudi construction industry with that of the USA and UK. Al Mansouri found out that restrictions of public accountability allowed no interaction between contractors and consultants. The general cultural belief is that consultants and the clients maintain better control on the project cost and schedule using D.B.B. He stated the following remarks in his concluding statements:

> *"The Saudi construction industry is inefficient due to the current operating work practice which separates the designers from contractors during the design stages" (Al Mansouri, 1988, 65).*

Moreover, (Assaf and Al Hejji 2006, Al Khalil and Ghafly 1999, Assaf *et al.* 1995) studied the causes of contractors' failures and delays in large projects in Saudi Arabia. They reported that change orders, the dominating adversarial work culture and contractual arrangements do not promote a collaborative atmosphere between the contractor, client and the consultant. Al Hazmi and McCaffer (2000) developed a Project Procurement System Selection Model (PPSSM) with the aim of assisting government agencies in Saudi in the selection of the most appropriate procurement system of their projects. Another study by (Jaweed, 2004) focused on developing an implementation model for D&B project delivery system. These research efforts were intended to encourage the adoption of D&B procurement system in the Saudi construction industry.

Recently, (Al Kharashi and Skitmore 2009) studied the causes of delays in large public sector projects in Saudi Arabia. They found out that the shortage of qualified labor and the current disagreement between clients, consultants and contractors on a single system of measurement of each party's progress to be among the main causes for delays. They reported that contractors and consultants need to work together in different work environment and mutually resolve problems.

It is evident that these researchers acknowledged the existence of the problems in the industry that prevent the consideration of using D&B option. However, it is disturbing to realize that the previous research explores the cause of this problem with little explanation revealing why this prejudice exists. As the Saudi construction industry remains committed to the D-B-B delivery option, it is insulated from other options that are commonplace in the rest of the world. There is an obvious void of unexplored information that should be reviewed in order to understand this phenomenon and ascertain why the D&B delivery option is unpopular in Saudi Arabia. The impediments that prevent its implementation must be exposed. Viable improvements which the industry may adopt must be defined.

1.3 Problem Statement

The lack of common understanding and limited information regarding the benefits of the D&B project procurement option are depriving the Saudi construction industry of

advantages benefits. This is now at the centre of an ongoing national debate. This research will bring us closer to understanding why D&B option is not widely utilized and what steps are needed to make it more popular. A new way is needed to approach and procure projects that is more efficient, collaborative and economical. Key questions that this research will answer include:

1. Why the traditional project procurement option is still dominant in the local construction industry?
2. What are the impediments to the adoption of D&B? Are they cultural, political, contractual, lack of knowledge, insurance and liability related system, or regulatory?
3. What is the common level of knowledge regarding D&B contracting amongst the various industry stakeholders and the consulting and contracting firms in particular? Is there a difference in understanding about D&B contracting amongst each sector of the industry stakeholders?
4. Would the local construction industry be prepared to consider adopting D&B if certain changes to the contracting contracts and regulations were introduced?
5. Can the local working environment accept having a contractor leading the design and construction efforts?
6. Would the private sector consider taking the lead in experimenting with D&B option or should the public sector initiate this change/initiative?

The findings bridge the gap between the known and unknown of this problem. They extend prior studies to explain this problem and develop a set of recommendations, answers, and concepts that are grounded in what the industry stakeholders reveal.

1.4 Aims and Objectives

This research aims at investigating the impediments to the adoption of Design and Build (D&B) project procurement option in the Saudi construction industry, and propose practical improvements and recommendations that would make D&B option an attractive option. The main objectives are:

- Find the reasons for the dominance of the traditional project procurement option in the Saudi construction industry.
- Define the impediments to the adoption of D&B contracting, whether they are cultural, political, technological, lack of knowledge or regulatory.

- Establish what would make the Saudi construction industry participants accept adopting D&B option and what changes to the current contracts and regulations are required.
- Understand what prevents the main industry participants (consultants, contractors, Public and Private sectors, Real-Estate Developers, Manufacturers, and Real-Estate Market Financial evaluators) from adopting D&B project delivery option at a wider scale?
- Propose a set of recommendations that would make D&B contracting an attractive delivery option.

These objectives will be achieved through the application of a mixed methodology and conducting direct interviews with a selected and representative sample as well as by conducting a case study of one D&B project. This will enable the formation of a holistic view about this research problem and the generation of solutions.

1.5 Outline Methodology

The selection of the research method was crucial since there is limited knowledge available about this topic. Both quantitative and qualitative data are required to fully define the impediments to D&B project procurement system. The research strategy is therefore exploratory in approach. This mode is chosen because an existing theory is not being extended. Rather this study is investigating the Saudi construction industry to find the prevailing impediments that prevent the adoption of the D&B contracting option. The review of the literature showed that mixed method strategy will enrich an exploratory study. This method allows both the qualitative inductive grounded theory method and the deductive quantitative method to be combined into a single study.

Both qualitative and quantitative data will be collected through direct interviews.

The decision to adopt this approach is aimed at reaching a deep understanding of the problem. Previous research is insufficient. The grounded theory methodology referred to by (Goulding 2002, Sekaran 1992) has the inherent ability to encourage emergence of new issues from the data gathered. Quantitative data will provide access to rigorous, solid and numeric data which can supplement the descriptive and narrative qualitative data. The investigation will be based on survey information utilizing structured, semi-structured and open-ended questionnaires and conducting direct interviews. Also a purposeful population sample that covers a broader range of

the industry's participants will be selected and interviewed. The sample is purposefully selected to include representatives from contracting, consulting firms, various private and public sector clients, developers, real estate financial evaluators, policy makers, and local insurance firms. The investigations are supplemented by the examination of a case study as part of the strategy of inquiry. The selected case study project is The King Abdullah University of Science and Technology (KAUST), an international research institute in the Western Region of Saudi Arabia which was initiated using the D&B contracting. This case study produced both descriptive and explanatory information that greatly contributed to the research study. Periodic site visits were made to the site starting in June 2007 and ending by September 2009. The investigation covered contractual, planning, design and construction aspects of this project.

Collected data and responses to the structured, semi-structured and open ended questionnaires were edited, coded for relevance and analyzed. Suggested improvements and recommendations are then proposed. Employing the conceptual ordering, categories from the open-ended interviews were transcribed, and analyzed. The main achievements were:

- Enabled identification and coding of key concepts, meanings and making inferences which led to defining the main impediments sought by this study.
- Defined relationships, linkages for developing theories, patterns, concepts and categories. "Telling the story" (Marshall and Rossman 2006).
- Offered areas of broad holistic content and potential solutions.

Recommendations to eliminate the impediments of the D&B project procurement strategy are provided. The findings help the Saudi construction industry stakeholders to consider the benefits of D&B option, and evaluate available procurement strategies. The findings encourage the local work environment, ingrained in the use of the lump sum contracts which is based on "bargained" fixed prices, to consider a change from this system.

1.6 Research Significance and Contribution

This work significantly contributes to the existing literature. It extends the current understanding of a broader concept and perception of the advantages of D&B delivery system in the following areas:

- By collecting mixed quantitative and qualitative interviews and listening and interacting with a much wider population sample for this research that covers a broader range of the industry's participants, a better understanding of the impediments to applying D&B is surfaced.
- The study identified potential, cultural, economic, lack of knowledge and regulatory problem areas. Responses to these problems are categorized, analyzed and solutions are proposed.
- The findings will help the key industry stakeholders, contractors, consultants and public sector clients to evaluate available project procurement strategies.
- It will initiate change and encourage discovering better and more efficient ways to procure and deliver construction work.
- The findings concern a wider audience including academic and non academics sectors, investors, developers, policy makers, contract administration, insurance firms, practitioners, arbitrators, standards organizations, manufacturing firms, students, and government representatives.
- The findings will encourage government institutions and policy makers to initiate the necessary reforms and set the example to consider implementing projects by using the D&B option.
- The study will suggest areas for future investigation that focuses on cultural barriers that are deterring or impeding the application of this procurement option and other areas where further research is recommended.

This study adds to the literature and its current understanding by defining the broader concepts and perceptions regarding the advantages of D&B option.

1.7 Delimitation and limitation

The study will be limited to defining the impediments to the adoption of D&B in the Saudi construction industry and proposing some solutions to this problem. Admittedly, there is the problem of limited access to some government projects financial data. However, direct interviews with colleagues in government offices helped in providing sufficient data about the extent of cost overruns and/or budget compliance for an acceptable number of government projects. Another problem was the limited published statistical data and research work about the D&B projects in

Saudi, their volume, magnitude and project results. Finding this data took longer time than anticipated.

1.8 Dissertation Structure

This thesis is structured into eight chapters with supporting appendices. The relationship between individual thesis chapters and supporting appendices is illustrated in **Figure 1.1**. The appendices include information related to the survey questionnaires, and pictorial survey (**Appendix F**) of the case study project.

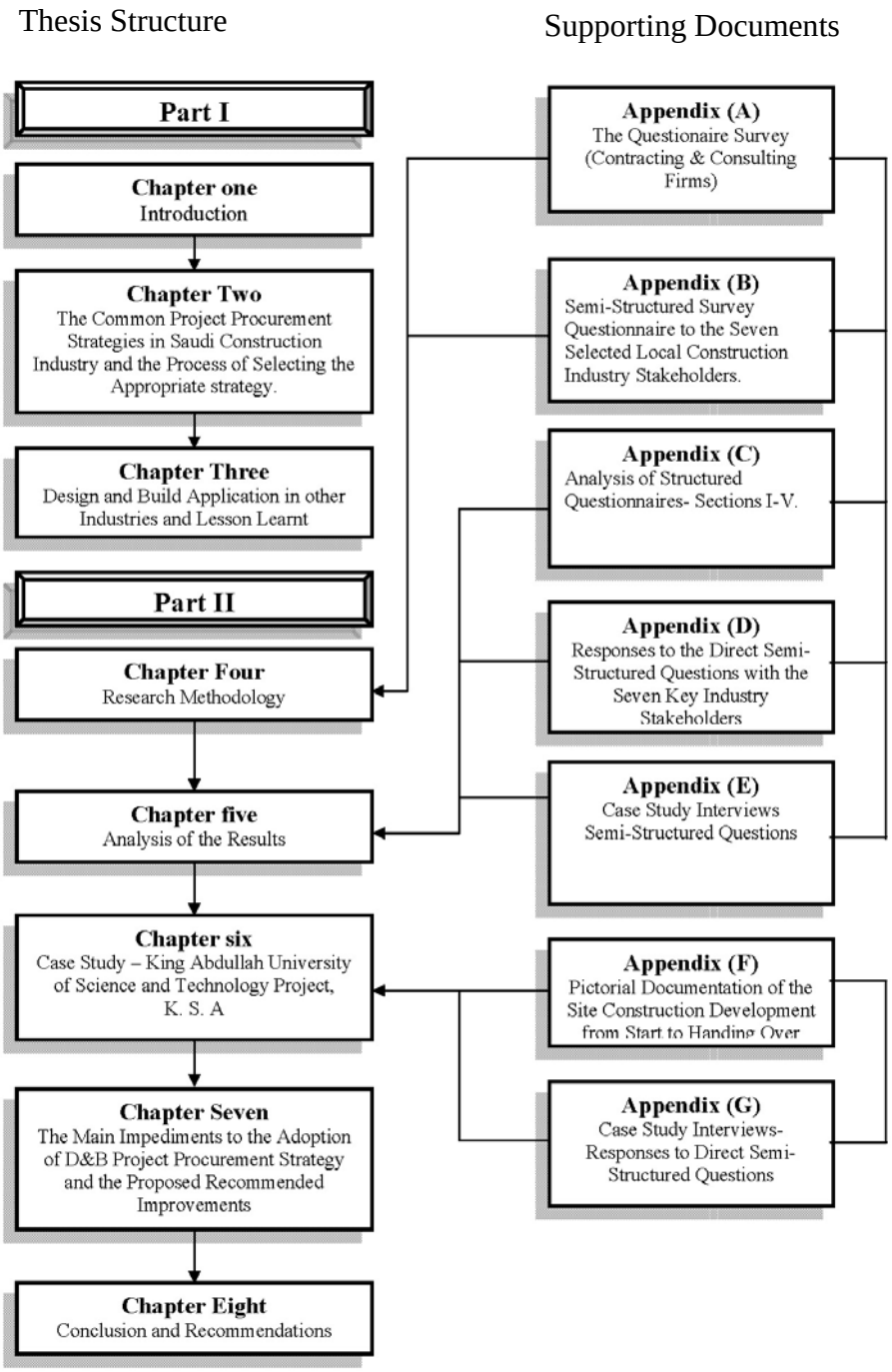


Figure 1.1: Thesis Structure

Chapter One discusses the purpose and aims of the thesis.

Chapter Two examines the common project procurement delivery options in the Saudi construction industry. It presents a brief background about the Saudi construction industry, how it evolved and how D&B delivery option is perceived by the Saudi construction industry stakeholders.

Chapter Three extends the literature review by studying what is known internationally about D&B contracting. It examines its application in the manufacturing, automotive, and digital industries. It examines its validity and implication on project delivery. This chapter also appraises the current working environment.

Chapter Four illustrates the selection of the research method used. It explains the process employed for the selection and why the mixed methodology was used. It explains the process for selecting and collecting the relevant data, the analysis methods, measures used, and procedures used to compile the results of the surveys.

Chapter Five presents the analysis of the results. It discusses the salient points raised in the interviews. Finally, the statements are descriptively analyzed to form concepts and understandings that are grounded in the respondents' statements.

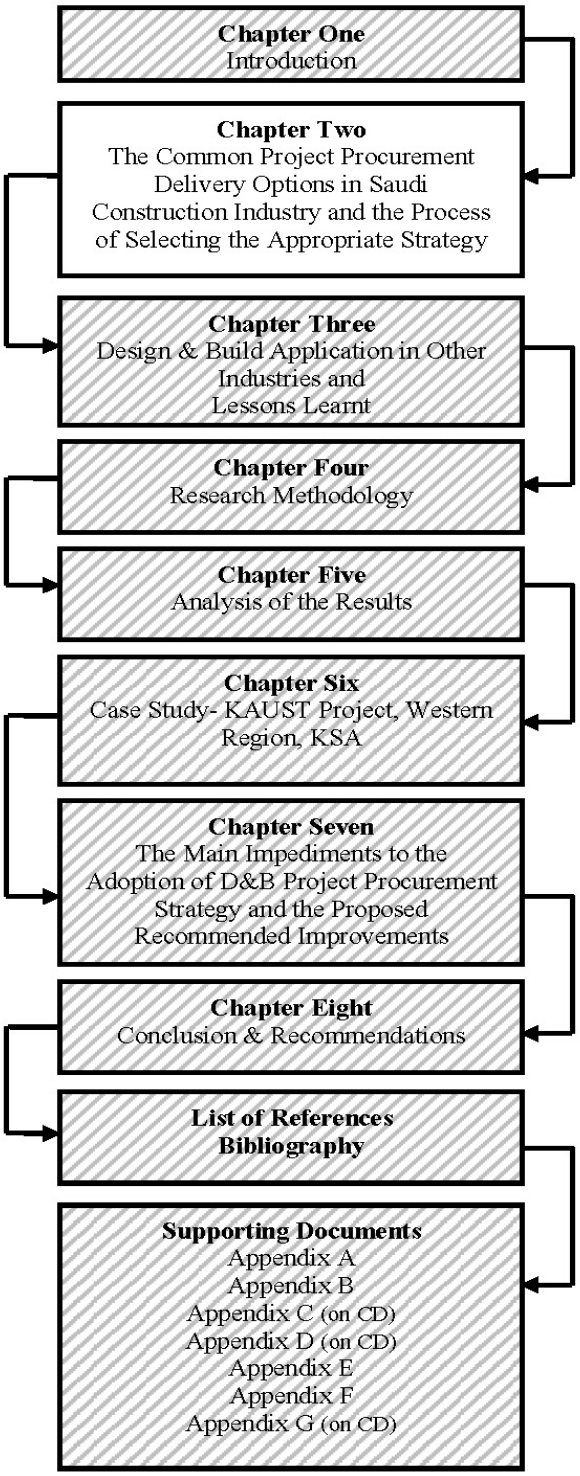
Chapter Six presents the case study project, The King Abdullah University of Science and Technology (KAUST) which was procured using the D&B option.

Chapter Seven provides the significant findings which include the main impediments to the adoption of the D&B project procurement option and the proposed recommended improvements. It summarises the central points raised and analyzed.

Chapter Eight concludes the research work. It presents the key findings of the preceding chapters. Based on these findings, a proposed set of recommendations is presented together with a working model to guide D&B on how to implement D&B projects. A final concluding statement is presented describing whether or not D&B can be considered as a potential delivery option in the Saudi construction industry.

Chapter II

The Common Project Procurement Delivery Options in Saudi Construction Industry, and the Process of Selecting the Appropriate Strategy.



2.1 Introduction

This chapter discusses the project procurement delivery process. It reviews the evolution of the Saudi construction industry and introduces the project delivery options practiced in the Saudi construction industry. They include the Traditional Design Bid Build (D.B.B), the Design and Build (D&B) and Construction Management (CM). The evolution of the Saudi construction industry over that past four decades is presented to understand the local construction industry practices. This chapter also examines internationally recognized procurement options, the local project procurement selection mindset, and the perception regarding the application of D&B option within the local operating environment.

2.2 Background to the Saudi Construction Industry

Saudi Arabia is a young nation with vast desert and arid areas characterized by a harsh and dry climate. The major developments in the Kingdom followed the discovery of oil in the 1930's. While the country lacked sufficient building materials, skilled labour and basic infrastructure, oil revenues made it possible for the government to import the required resources and attract a wide range of regional and international firms with construction expertise. In the 1960's major construction activities occurred that were predominantly initiated by the government. The government created the National Central Planning Organization (NCPO) in the late sixties with the prime duty of establishing, implementing and managing strategic development plans. These ambitious plans aimed at building the nation's urban, industrial, civic, religious and infrastructure sectors, (Al Jarallah, 1983). The first and second plans, spanning from (1970-1979), were primarily directed at building the nation's infrastructure services, water services, power distribution, and roads networks which were desperately needed. Apart form the defense related projects, the majority of these projects were procured using the traditional procurement system (Rehemi, 1983). Over SR 800 billion ($213 billion) was allocated for completing these two plans, (Achievement of the Development Plans, 1979). The third and fourth plans spanning from (1980-1989), called for the completion of the remaining infrastructure and establishing the basis for operations and maintenance programs. These were the foundations of the non-oil related industrial and commercial sectors that created employment opportunities for young Saudis, (Achievement of the

Development Plans, 1989). According to (Al Mansouri, 1988) the majority of the country's infrastructure work was completed by the end of the third strategic plan and the commonly used procurement system was the traditional D.B.B system. The total government expenditure was $234.4 billion on all other projects. Amjad (1998), reported that the work force in the construction sector during the 1980 reached around 330,000 persons or (13.3%) of the total labour force of 2,471,000. In 1983, the number had increased to 485,000 with the total recorded work force at 3,189,000 or (15.2%). The majority of the work force was foreign, predominantly from Asian and Middle Eastern countries. The majority of the consulting and contracting firms were European and American. This long construction boom was very attractive to many international contracting firms. Bank loans were relatively easy to obtain and the construction market offered a high margin of profit (Ubaid, 1991).

The Fifth and Sixth Development Plans (1990-1999) were aimed at public housing, education, recreational and commercial development, as well as, the creation of incentives for the private sector to participate in the economic growth, (Achievement of the Development Plans, 1999). This period recorded a steady GDP increase of 1.8% per annum. The government main goals were to modernize the Saudi industries and create other economical opportunities that would lessen the government's dependence of the oil revenues (Amjad, 1998). During the early 1990's, following the Gulf war in 1991, the international recession affected the general Saudi markets. During the Fifth Plan, the volume of public projects reduced significantly (Jannadi, 1997) and as a result, many contracting firms left the market, (cited by Amjad 1998). However, construction activities increased during the Sixth Strategic Plan. The private sector became more involved at the macroeconomic level. Substantial Saudi investment capital began to channel back from abroad. According to Gulf Construction magazine (May, 1997) the private sector contracted over $16.0 billion dollars on various projects between 1996 and 1997. MEED (2007) reported a study by SAUDI ARAMCO, Oil Company that the construction industry will require a skilled work force of more than 200,000 by 2008 to cope with ARAMCO and Saudi Arabian Basic Industries Corporations (SABIC) planned projects alone, compared with 36,000 workers in 2005. Sabic is the national company that was established in 1971 to set up and operate the hydrocarbon and mineral-based industries in Saudi

Arabia. This year, an article published in the local newspaper Arab news, July 2010 by Hanafi, one engineer at SABIC stated that last year alone there were 130 delayed public sector projects. He attributed the delays to a number of reasons including; the bidding process, delayed payments, lack of available skilled resources and the lengthy contract award process that keep the consultants away from the contractors.

A report by the local Construction Week Magazine, (2009) showed that the total committed construction spending by the public and private sector for published projects that exceed $400 million and those planned for execution between January 2007 and the next five years are more that $ 72.0 billion, as illustrated in **Table 2.1.**

Table 2.1 Public and Private Sector Level of Committed Investment in the Seventh and Eighth Five Year Development Plans.

No.	Sector	Value in US $ Dollar Billion (2006– 2009)
1.	Commercial and Business	11.0
2.	Housing	27.4
3.	Hotels, Resort and Tourist Villas	6.3
4.	Social, Hospitals and Philanthropic	5.5
5.	Urban Development	12.0
6.	Industrial	10.6
Total		**72.5**

Source: Construction Week (2009)

The Seventh Plan (2000-2004) had a number of objectives which included:
expanding the maintenance and operation programs, establishing human resources programs, increased spending on the defence infrastructure, and, most importantly the creation of partnering schemes with the private sector, (Achievement of the Development Plans 2004). This period witnessed the initiation of the major privatization schemes and the introduction of new commercial banks. The local Saudi Electricity Company (SEC) and Saudi Telecommunication Company became private companies. According to a report by the Gulf Construction (2007), SEC opened the door to the private sector in 2006 on BOT arrangements to increase its power generation capacity. The cornerstone for the Seventh and Eighth Development Plans was the creation of the new four economic cities across the nation as is shown in **Table 2.2.** King Abdullah Economic City at Rabigh city along the west coast,

Table 2.2. Summary of the Salient Features and Components of the Four New Economic Cities in the Kingdom of Saudi Arabia

	Project	Client	Project description	Value in (Billion $)	Status
1	King Abdullah Economic City at **Rabigh**	Emaar	55 million-square meter mixed used development at Rabigh featuring the world's largest port, industrial districts, educational institutions, residential districts and financial island.	27,000	Launched in April 2006
2	**Jizan** Economic City	Local and regional investors	It will cover an area of 100 million square meters and include a seaport, an industrial zone, a commercial business district, residential areas, hospitals, schools and many other vocational and training institutions and create jobs for 500,000 people.	20,000	Launched in February 2007.
3	**Hail**, Prince Abdulaziz Bin Mosaed Economic City	Local and regional investors	Over 156 million-square meter city. It includes a major Logistics centre, education, agriculture, Food processing service, Mining area Entertainment and Residential districts.	8,000	Launched in November 2006.
4	**Madinah** Knowledge Economic City	Local and Internatio-nal investors	Over 4.8 million-square meter city. It includes knowledge based industries, IT, Life science, The Prophet centre.	6,700	Launched in December 2007.

Source: Oxford Business Group. Saudi Arabia Report (2009)

in partnership with Emaar, a UAE based developer's firm was the first to proceed. It was followed by Hail Economic City, Madinah Knowledge and Economic City and Jizan Economic City. According to The Saudi Arabian Monetary Agency Report, (2007) these economic cities alone will contribute $150 billion to the GDP by year 2020 and provide job opportunities for 1.2 million Saudis and attract investments worth more than SR300 billion. A recent report by the Construction week (2009)

indicated that these cities are being built in several phases, over a period of 10 to 20 years. The individual projects within these new cities will be procured along the BOT and D.B.B project procurement options. MEED (2004), regarding construction trends in Saudi Arabia reported the following:

> *"The high oil prices and an upsurge in private sector investment have transformed the Gulf projects markets from recession into boom. The forecast for the Saudi Construction market during 2004 to 2006 is expected to reach $55,000 million. This shows an increase from $8,000 million of 2002", (MEED 2004).*

Forbes Arabia special report on the Saudi economy (2005) indicated that around $2.5 trillion of Saudi money that was previously invested in Europe and the USA had already been deposited in the Saudi local banks. A research by (Almohawis *et al.* 2005) showed that the Saudi construction industry contributed about SR40 billion over the last decade to the national GPD and employs about 14.4% of the total work force in the kingdom. A report by the (Business Week 2006) about the construction in Saudi Arabia indicated that about $237.4 billion are committed to upgrade the electrical power network, housing, water, roads network and education sectors in Saudi over the next three years. According to vice president of the Engineering and Operations Services at SAUDI ARAMCO, Mr Salim Al Aydh, the kingdom will demand dexterity and highest professional standards. He added:

> "*Last boom we invested in construction of new plant facilities. This time we will invest in the capacity of our people in engineering, procurement and construction"* (Business Week, 2006, 2)

A report about the Saudi Construction Sector by the U.S- Saudi Arabian Business Council 2009 indicated that the number of ongoing construction projects in the Gulf is valued at $1.9 trillion and one quarter of the developments are located in Saudi Arabia. Recently delayed 34 contracts, each with a value over $500 million were awarded. H.E Amr Al Dabbagh, Governor of Saudi Arabian General Investment Authority (SAGIA) reported that the economic downturn benefited the Saudi economy. Some of the delayed projects are being considered for EPC Procurement (Engineering, procurement and Construction). He added:

> *"The challenge now is how much we can do in 24 hours a day seven days a week"* (Construction Sector Report, 2009, 2)

A recent report by The Local National Commercial Bank (NCB 2010) indicated that 56,000 building permits were issued in 2007, accounting for 73 million square meters of floor areas. This would potentially generate a combined expenditure of USD 40 billion. Currently the kingdom has 687 projects which are at the execution phase and valued at USD695 billion. The abundance of liquidity with the government and the new regulations encouraged the developers and investors to explore opportunities in the construction industry and build relatively large projects in a very challenging short period of time. This relatively massive investment by the private sector came as a result of the new change in building rules and regulations announced by the Saudi government in (2007), which permitted an increase in building heights and total built up area. While according to [Amjad 1998, Al Sultan 1987, Assaf *et al.* 1995, Ubaid, 1991,] the Saudi construction industry is well versed with the traditional D-B-B procurement system this does not suit the desire to build faster and for less which is the new culture for developers and the private sector, (Al Sobiei *et al. 2005,* Jaweed 2004, Al Khalil and Ghafry 1999). With all the reported investments in the real estate market one question remains to be answered; how are investors who are concerned with capital investments and return on investments planning to procure their projects?

2.3 The Importance of Selecting the Appropriate Project Procurement Option

According to (Ling and Poh, 2008, Murdoch and Hughes, 2000) the procurement strategy is the process of choosing the optimum route available that provides clients value for money that is appropriate for the overall balance of objectives and priorities at the minimum cost and least time. Procurement is the process concerned with how clients, who perceive a need to require a building, approach the construction industry to obtain that building (Chen *et al.* 2010). Choosing the appropriate procurement option according to (Murdoch and Hughes 2000) could reduce the construction cost by up to 5%. The alternative contractual arrangements options, that are often called procurement paths, vary in the way they work for clients. Each method is ideal for some of the client's priorities and weaker for others. No procurement path is best in all circumstances. Kerzner (2003) believes that consultants have the obligation to professionally advise their clients regarding the optimal delivery option based on

their understanding of the clients' design brief, budget, time constraints, their expressed or implied business and quality objectives. The choice of a delivery option in construction as pointed by (Watt *et al.* 2010, Beard *et al.* 2001) is certainly not a casual one. The choice can impact the cost and schedule of the project. In the UK, The National Economic Development Office (NEDO, 1985) includes a chart prepared by the Building Round Table Committee as illustrated in **Figure 2.1** which is intended to help clients choose the appropriate procurement route which suits their business needs. It lists nine pertinent weighted criteria with sub-categories that guide potential D&B clients to evaluate their priorities and select the optimum procurement system under the (D.B.B), the (D&B) and Management (CM and MC) procurement option. The procurement option that responds to the requirements of the client is the one that scores the highest points. Murdoch and Hughes (2000), (Cox and Thompson 1998) defined the following criteria for choosing the procurement methods:

- The level of the client's involvement with the construction process.
- Separation of design from management.
- Reserving the client's right to alter the specification.
- Clarity of client's contractual remedies.
- Complexity of the project and allocation of risks.
- Speed from inception to completion, and certainty of price.

Beard, *et al.* (2001), advocate that appropriate delivery option has legal, ethical, economical and insurance implications to the owners, users and public at large, in addition to targeting the early completion of work.

2.4 The Influence of the Project Management Discipline on the Procurement Option Selection

Project management as a discipline is capable of successfully achieving the shortest time, lowest cost and best quality standard (Papke-Shields *et al*, 2010, Kerzner, 2003). According to (Kerzner, 2003) unlike over-the-fence-management, project management offers standardization, proper project planning, and cost control:

> *"By the 1990s, companies had to realize that implementing project management was a necessity, not a choice. The question was not how to implement project management, but how fast could it be done?* (Kerzner 2003, 47).

	Note: This dot in each box indicates that the procurement option satisfies the requirement. Careful evaluation of the extent to which the procurement path satisfies the criteria may be required to determine the best route for the project.		Traditional						Design and build									Management						
			Sequential			Accelerated			Direct			Competitive			Develop and Construct			Management Contracting			Construction Management			
		Grade		Weighting	Total		Weighting	Total		Weighting	Total		Weighting	Total		Weighting	Total		Weighting	Total		Weighting	Total	Reasons/comments
Timing	Earlier than realistic completion								●									●			●			
	Completion in realistic time important					●			●			●			●			●			●			
	Time not as important as other factors		●			●			●			●			●									
	Other:																							
Price	A fixed price is required for construction before commitment to proceed		●						●			●			●			●						
	Target price plus or minus no more than 5%		●			●			●			●			●			●			●			
	Target price plus or minus 5-10%		●			●			●			●			●			●			●			
	Other:																							
Complexity	Complex construction		●			●												●			●			
	Moderately technical construction		●			●			●						●			●			●			
	Simple construction		●			●			●			●			●									
	Other:																							
Quality	Basic competence		●			●			●			●			●									
	Adequate		●			●			●			●			●									
	Good		●			●			●						●			●			●			
	Prestige		●			●												●			●			
	Other:																							
Controllable variation	There may be a need for some variations		●			●												●			●			
	There will be absolutely no need for variations								●			●			●									
	Other:																							
Competition	All construction work must be chosen by competition		●									●			●			●			●			
	Construction and management teams must chosen by price competition		●															●						
	Other factors are more important		●			●			●			●			●									
	Other:																							
Division of responsibility	Client can manage one firm		●			●												●			●			
	Client only wishes to manage one firm								●			●			●									
	Other:																							
Professional liability	Not important								●			●			●									
	Professional responsibility is required from design team		●			●												●			●			
	Other:																							
Risk avoidance	Client will retain risk and control																				●			
	Client require to share risks		●			●												●						
	Client is prepared to pay to transfer risk								●			●			●									
	Other:																							
	Totals																							

Figure 2.1 Procurement Selection Chart. Source : NEDO (1985)

Isik *et al.* (2009) advocate that effective project management is key for the successful accomplishment of sophisticated projects. Citing the work of (Koskela, 2003), (Bertelsen and Koskela 2004) referred to project management in construction as managing transformation by managing contracts, establishing quality and safety requirements which leads to an increase in value, productivity and optimization. Although (Brown *et al.* 2007) believe that project management in construction has a poor track record nevertheless, they argue that with the proper human capabilities and experience of the project manager this discipline can achieve the project's quality, schedule and cost targets.

Historically, projects were procured under the traditional project management option where an architect, quantity surveyor or an engineer would manage the various stages of the project. The architect would assume the role of the project manager and recommend to the client the best procurement option to select contractors, and the standard form of agreement to use. The architect would also manage the project on site. With project management, the job is managed as a project. The project manager leads the multidisciplinary team and manages all planning, procurement, technical, costs, financial, design and construction aspects of the project. The clients have one person to refer to.

The relevance of the above background to our present study is that international firms introduced to Saudi construction industry the importance of recognizing the three main objectives of time, cost and quality in design and construction and the timely completion of projects (Amjad, 2003). International firms entered the Saudi market between 1970 and 1998. A survey by the local Gulf Construction Magazine (Aug. 2001), showed that the number of international construction and management firms that have been practicing in the kingdom increased from 79 in 1980 to 324 in 1999. These international firms have continued to offer, and practice this service as a discipline in the Saudi construction industry, (Amjad, 2003).

2.5 Procurement Delivery Options in Saudi Construction Industry

The current project procurement options and selection process commonly followed in Saudi is discussed to understand the present Saudi operating environment. This is essential since the scope of this research is to study the impediments to the adoption of D&B project procurement delivery option in Saudi Arabia. According to [Al

Sobiei *et al.* 2005, Jaweed 2004, Amjad 1998, Ubaid 1991, the Arriyadh Development Authority (ADA), Control Regulation, 1988, and The Saudi Engineering Committee bulletin (2A/ 1991) Al Mansouri 1988, Al Sultan, 1987, Al Jarallah 1983, Rehemi 1983,] the three commonly recognized project procurement options in Saudi construction industry are:

1 Traditional method (D-B-B).

2. Design and Build (D&B).

3. Construction Management (CM).

In his survey about the effects of professional training upon time overruns in Saudi construction (Amjad, 1998), found out four recognized forms of consultancy and construction contracts in Saudi, as listed below. These contracts which are very much in line with the contracts in the Western world, spell out remedies for one party against the other, for failure to perform or for defaulting on any of the terms.

I The Ministry of General Public works form of contract or "the blue book" as the term is commonly referred to locally, which is a government developed standard form of agreement applied to all of the public projects.

II The modified International Federation of Consulting Engineers (FIDIC) contract which is mainly used by the private sector. This standard form of agreement is largely an interpretation of the FIDIC contract.

III The bespoke form of contract which has clauses and articles from various agreement sources.

IV Specific contracts developed by large semi government organizations such as: The SAUDI ARAMCO Arab American Oil Company, The Saudi Royal Commission of Jubail and Yanbu industrial and petrochemical Cities and other semi government organizations.

The courts in Saudi will approach these contracting forms with the same rules that apply to all commercial contracts. The main variations in the Saudi contracts from the European contracts are in the area of working days, number of working hours, penalty clauses and type of arbitration. The latter is through the government grievance system and the maximum liability and liquidated damages are limited to 10% of the contract value. Tax clauses are replaced with Zakat payment. The choice of the contract according to (Jannadia *et al.* 2000) depends on many factors including; the owner's preference, the public law (for government projects), current

market conditions, project location, project finance, schedule, scope of work, risk allocation and the completion date, (cited by Amjad 2003, 07). It is common practice in Saudi for local consultants to start a project by defining the client's brief and value system from the outset. Beard *et al*. (2001) described this stage as the problem seeking stage that carefully defines the owner's preferences. The briefing stage process therefore, focuses on the following main tasks:

- What is the client's basic objective for the project including the quality level?
- Who are the end users and what is the efficient way of gaining their input?
- How should the information be organized?
- What is the client's budget limitation?
- What is the completion date of the project?
- What are the physical and environmental requirements?
- Codes and regulations analysis. Zoning analysis building codes.

According to Jergeas and Fahmi (2006) research showed that producing a clear and comprehensive RFP is essential prerequisite for delivering a project that meets the owner's and user's needs

2.6 The Traditional Procurement Method

The traditional D.B.B procurement method is internationally the mostly recognized and popular delivery option. It is referred to as general contracting, (Murdoch and Hughes, 2000). It is a two-phase procurement process whereby the client commissions an architect or an engineer to prepare the drawings, bills of quantities and specifications, under a design services contract. They act as the client advisors throughout the project. Subsequently, the client separately selects a construction contractor by competitive bidding or negotiations to build the facility under a construction contract for "at risk" construction. This procurement option referred to by the (AIA, 1994) as the Design-Bid-Build (D-B-B) or the sequential system. Each activity starts after the completion of the previous one. It was still used on nearly two thirds of the projects in the USA in the beginning of 2000. This option, according to Beard *et al.* (2001), was the choice for delivery option throughout the world for the last century. The contractual and organizational arrangements of this option are shown in **Figure 2.2.**

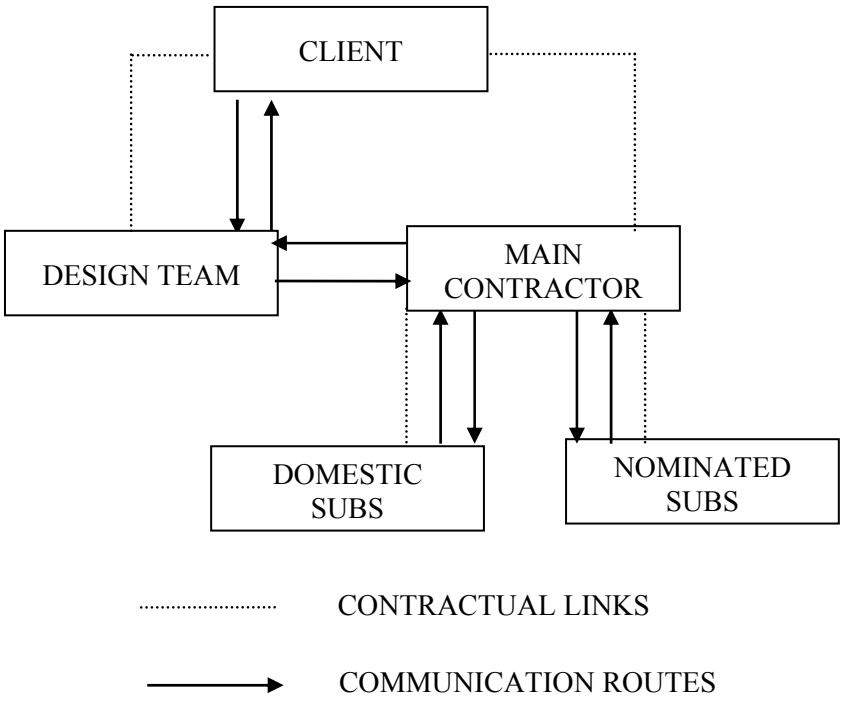


Figure 2.2. Typical Project Organization – Traditional Method

In Saudi, the D.B.B option is the common procurement path in the Saudi construction industry. A study by (Al Mansouri, 1988) showed that Saudi clients preferred the traditional procurement because they felt that it offered:

1. The opportunity to have the lowest price. Subjective evaluation is eliminated.
2. Certainty and stability of price and schedule from the outset.
3. Design and Build is more risky than other procurement methods.
4. Clients were accustomed to a direct interface with all project participants.
5. Clients preferred to maintain contractual separation between design consultant and the contractor.
6. The Low bid system offers objectivity, since price is the only selection criteria. This is enough justification to continue with this low price system.

Competitive bidding is deeply rooted in the Saudi tradition. Laws requiring competitive bidding have been in existence since 1963, (Al Mansouri, 1988). The award to the lowest bidder provides public protection from corruption. Al Mansouri concluded:

> *"The Saudi construction industry is inefficient due to the current operating work practice which separates the designers from contractors during the design stages"* (Al Mansouri, 1988, 165).

Another study by (Al Barrak, 1993) examined the causes of contractors' failure in Saudi and the causes of delays in large projects. Among financial and schedule reasons, his findings stated that the dominating work culture and the prevailing contractual arrangements which are based on the traditional procurement system do not promote a collaborative atmosphere between the contractor, client and consultant.

Since Al Barrak's study , Assaf and Al-Hejji (2006) studied the causes of delays in large construction projects in Saudi Arabia and reported that change orders, shortage of skilled labors and delays in reviewing and approving design documents were among other seventy three causes of delays identified in their study.

According to (Al Sobiei *et al.* 2005, Alhazmi and McCaffer 2000, Al-Barghouthi 1994, Al Sultan 1987, Al Jarallah 1983) the design and construction activities in Saudi are negotiated separately in two distinct stages. Alhazmi and McCaffer (2000) discovered that the Saudi government purchasing contract regulations require public projects to be fully designed, tendered publicly and opened to qualified competitors. These regulations limit the use of D&B contracting. Special permission is required from the concerned authority before certain projects can be tendered using D&B. To date, the low bid method of competitively selecting contractors remains the predominant system used in Saudi, (Amjad, 2003). The public procurement system according to Amjad is still based on the traditional D.B.B, low bid method (Amjad, 2003). The appointed consultant is responsible for the preparation of the contract documents, as well as, compiling and documenting and submitting for building approval to the necessary local authorities. The client can nominate and introduce a certain number of specialist subcontractors, (NS) as necessary, to participate in specific design elements. The contractor's role is to tender and submit an offer to build the project and start the construction once all the design documentations are agreed. The components of the traditional sequential path as described by TAB, (1985) are shown in **Figure 2.3.** The main features of this option are as follows:

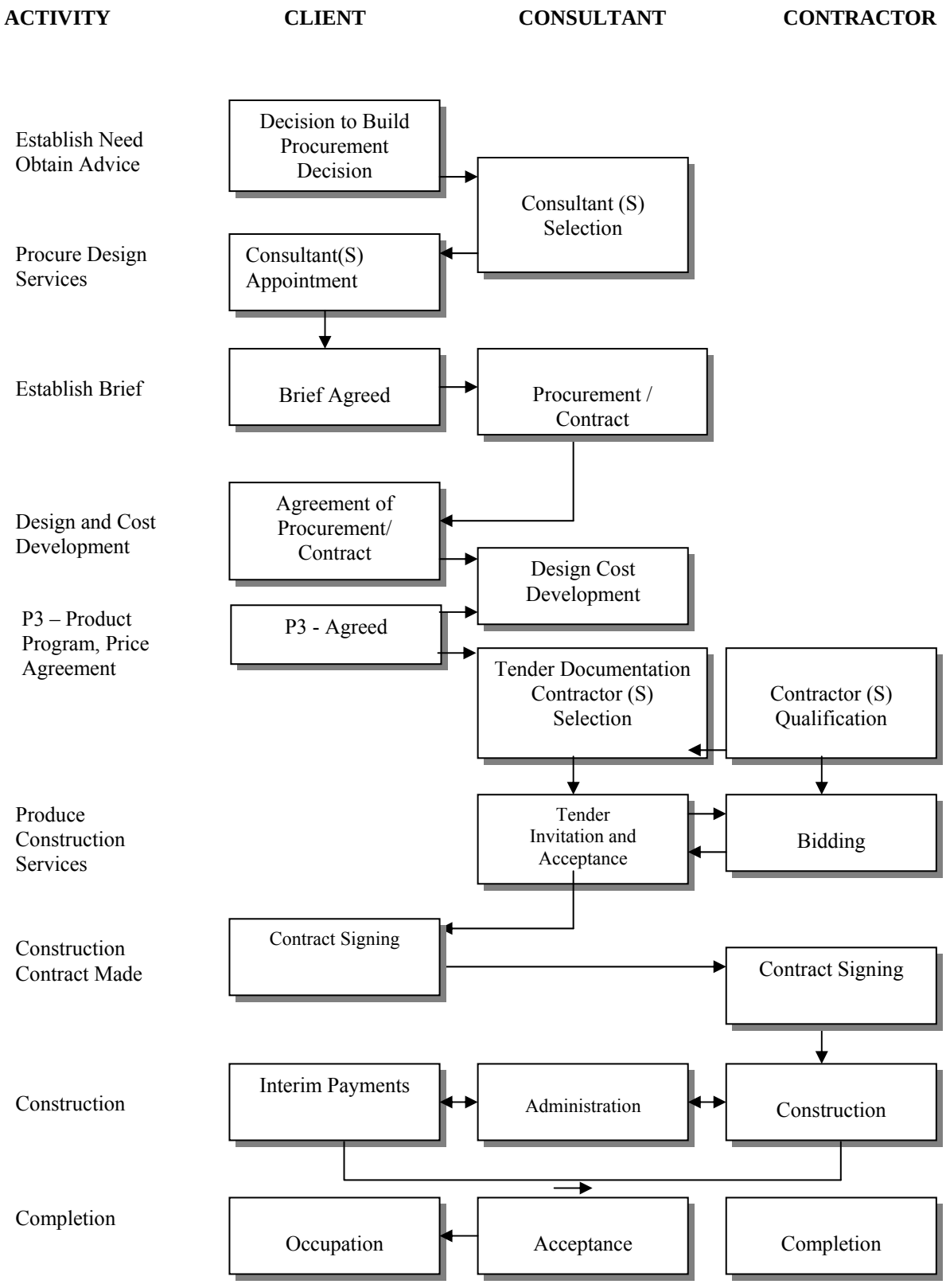


Figure 2.3. Components of the Traditional System Sequential)

Source: NEDO (1985)

1. The architect prepares the final design and construction drawings, the specifications and the bills of quantities (BOQ) documents for the project. The BOQ documents represent a key element of this procurement path and can only be accurately done once the design is complete.
2. During the preparation of the BOQ, the client and the consultant would pre-qualify and select a number of contractors and invite them to tender for the construction work.
3. Following the pre-qualification stage, the tender documents would be issued to the selected contractors. The tendering period is normally decided by the client in consultation with the consultant. Factors that affect the duration largely depend on the size of the project, completion date, and quality standards required.
4. The returned bids are analyzed and reviewed by the consultant's quantity surveying department and the designers to check their compliance with the conditions of contract.
5. The contractor's offer is based on the itemized BOQ prepared by the consultant's quantity surveyor (QS). The contractor has no responsibility for the design completeness and quality.
6. A further stage is customarily allowed for the negotiation and bargaining between the potential contractor in one hand, and the consultant and client on the other.
7. A complete design package simplifies the planning of the of the construction work. It eliminates any schedule interface between the construction activities and the design activities.

The design team works separately from the contractor due to competitive bidding on lower prices. The design Phases as shown in **Table 2.3** are produced according to the division set out by the Saudi Engineering Committee and confirmed by the (ADA) which follows to a great deal the RIBA design stage requirements and submittals.

The advantages and disadvantages of the D&B project procurement option are summarized in **Table 2.4.**

I Programming stage.

II Preliminary design stage.

III Design development stage.

IV Construction documentation stage.

Table 2.3 The Division of Design Phases and their Contents.

Phase-I 20% **Design Concept (Direct assignment Or Tender)**	**Phase-II 20%** **Preliminary Design**	**Phase-III 30%** **Design Development**	**Phase- IV 30%** **Final Design**
Preliminary Engineering Concepts (structural, mechanical, electrical) • Design parameters • Coordination of design • Security system design • Fire protection strategy. Preparation of a Preliminary Construction Cost Estimate.	**Electrical Systems** • Power • Lighting • TV./public address. • Communication systems Alarms and detectors • HVAC power • Fire Detection systems • Alarm systems • Protection systems • Other systems • Design coordination.	**Final Design and Calculations of Electrical System** • Power • Lighting • TV./public address. • Communication systems • Alarms and detectors • HVAC power • Detection systems • Alarm systems • Protection systems • Other systems • Design coordination	**Final Mechanical drawings and documents** **Final Electrical Drawings and Documents** (According to the design standards) **Final Fire Protection System Drawings** (According to the design standards)
	Services Coordination Report • This report shall include the documents and drawings that indicate coordination of engineering systems (mechanical, electrical, fire protection) and their requirements.	Services Coordination Report • This report shall include the documents and drawings that indicate coordination of engineering systems (mechanical, electrical, fire protection) and their requirements.	Preliminary Submission of Phase-IV Works (REVIEW)
Design Review	Design Review	Design Review	Design Review
• Review the Phase with the Client representative then submit it to Client for review.	Landscape design • Irrigation system	Final Landscape Design with complete details	• Final submission of Phase-IV works
• Submit the architectural drawings in slide format and point power files and a (CD)	• Signage system concepts	**F**inal Design of signage concept with details	**(REVIEW)**
	Submission of BOQ format	Preliminary submission of BOQs/documents	
	• Specifications draft /format	• Specification draft	
	• Construction cost estimate	• Final construction cost estimate	
	• Submit a preliminary report of the phase for Client review **(REVIEW)**	• Submit a preliminary report of the phase for client review **(REVIEW)**	
	• Final submission of Phase-II : update submission as per client comments (**REVIEW)**	• Final submission of Phase-II: update submission as per Client comments (**REVIEW)**	
	• Submission of all engineering and architectural proposals (without details) on CD/power point.	• Submission of all engineering and architectural proposals (without details) on CD/power point.	

Phase-I 20% **Design Concept (Direct assignment Or Tender)**	**Phase-II 20%** **Preliminary Design**	**Phase-III 30%** **Design Development**	**Phase- IV 30%** **Final Design/Construction Document**
Development of concept based on client's comments. • Development of concept	Development of Architectural Concept (Plans, elevations, sections, perspectives) .	Final Design of Architectural Concept (plans, elevations, sections, perspective)	Prepare Final Architectural Drawings • Complete Architectural Details
Revision of space program with the Client • Prepare design Concept • Traffic Study • Interior/exterior perspectives (as required) Study model	Interior Design, Furniture and Fittings Concepts • Prepare layouts drawings	Final Interior Design • Furniture and Fittings details with samples. • Interior Design with samples.	Final Interior Design Documents • Submission of all samples, materials, colour scheme, fabric, furniture book, etc.
	Structural Systems • Soil investigations. • Building materials • Design parameters • Adjacent structures • Design coordination	Final Design and Calculations of Structural Systems • Building materials • Design parameters • Adjacent structures • Design coordination	Final Landscape Drawings • Levels • Hardscape • Softscape • Irrigation system • Types of Plants (schedule)
• Landscape Preliminary Design			
Prepare supporting studies • Topographic survey • Environmental engineering recommendations • Identifying hook-up points on the site plan and coordinate with the concerned authorities.	Mechanical Systems • HVAC system • Water supply • Drainage • Elevators (vertical transport) • Other facilities and Design coordination	Final Design and Calculations of Mechanical Systems • HVAC system • Water supply • Drainage • Elevators (vertical transpot • Storm water drainage	Signage (interior/exterior)
	Revised Security System Design	Final Design of Security System with complete details	Final Structural Drawings (According to the Design standards).

Source: ADA Control Regulations (1988)

Table 2.4. The Sequential, Traditional Method, Advantages and Disadvantages

Advantages	Disadvantages
• Better control on the design quality and aesthetics of the project due to the presence of an independent professional advice.	Takes too long to design and construct and the cost of the project will increase as a result.
• Direct interface between the client and the designers and the nominated subcontractors (NS)	Limited if any chance for parallel processing of design and construction activities to save time.
• Having a complete design and construction package to tender with a measured BOQ.	The generated income from the development will be delayed.
• Design and construction costs are negotiated separately and the client would be aware of the total cost of the project at the start.	Design variations and missing information will cost the Client additional money.
• The consultant is liable for the design and the contractor would be liable for the construction. Responsibilities are well defined. Risks are apportioned accordingly.	The Client is not taking full advantage of the contractor's buildability knowledge and experience at the design stage since the contractor's role and responsibilities are limited to the construction activities.
• The client and the architect have the power to introduce and control the variation on site and monitor the cost.	The contractor's price will tend to be high in order to cover for the market price fluctuations and risk of getting the material and skilled labour on time.
• Delays by the contractor to complete on time will render the contractor liable for compensation to the Client under the liquidated damage clauses.	Any inconsistencies in the design documents would be subject to the risk of variations and claims and lengthy and costly disputes.
• Relatively cheaper cost since the design is complete and effectively no greater risk and uncertainties are envisaged	Client must appoint a supervisor to act as a Client agent to administer and control the project on site, supervise the construction and do the handing over.
• Contractor prices the project based on the set of drawings and BOQ and bears all risks if his/her estimate is wrong.	Bidding can not start without having the fully detailed BOQ and design details.
• Two distinct stages where cost can be estimated properly planned and scheduled and controlled.	Since lower price is the common selection criterion, Clients may miss other value for money opportunities. Initial low bid may not result in final best value.
• Financial liabilities are defined and clear between the parties to the contract. Separate bonding can be issued.	Since designers and contractors roles and relationships are separated this will create a "them and us" attitude which may negatively impact the progress of work.
• Client is instantly aware of the entire project progress.	Designer and contractor have different roles and Client is the arbitrator.

2.7 Design and Build (D&B) Procurement Option

Design and Build (D&B) is a project delivery system where a single entity performs both design and construction activities under a single contract. The client contracts a single point of responsibility for design and construction services. The contractual and organizational arrangements of this option are shown in **Figure 2.4.** This procurement method has its roots in ancient history. It can be traced to the times of Hammurabi (1795-1750 BC), and the world's first metropolis, the great city of Babylon (Beard *et al.* 2001). The Code of Hammurabi has a reference to a single responsibility for design and construction. This remarkable code of law is the earliest known example of a ruler proclaiming publicly to his people an entire body of law. AIA (2003) showed that there is evidence in the United States that indicates a spread to other procurement methods occurred in the 1980's. The 'traditional route' where the building is fully designed, and the contract administered by an architect was losing favour.

The study showed that less than 40% of construction (by value) was procured 'traditionally' in 1998, as compared to over 70% in the mid-eighties. In D&B designers and constructors are placed on equal professional footings, which results in effective communication and instantaneous resolution of design issues. Design/ Builder entity is accountable to and at risk for interpreting and meeting the client's brief, cost, schedule, quality and management of the project. Clients are able to avoid the role of referee between designers and builders. Prior to construction, the Design Builder warrants to the client that the design documents are complete and free from error. (This is in contrast, with "traditional" D.B.B, where the owner warrants to the contractor that the drawings and specifications are complete and free from error.)

In the Saudi construction industry, D&B procurement delivery option has been used mainly by the public sector (Jaweed, 2004, Alhazmi and McCaffer 2000). It was utilized for procuring mega size projects predominantly in defence, industrial and special projects such as: refineries, and airports, which require high sophistication and expertise, (Amjad 1998, Achievements of the Development Plans, 1970-1998, Ubaid 1991). Saudi clients opted for D&B option for large and complex projects because local knowledge and capabilities were not available to manage complex projects, (Amjad 1998, Al Mansouri 1988, Al Sultan 1987, Rehemi,1983).

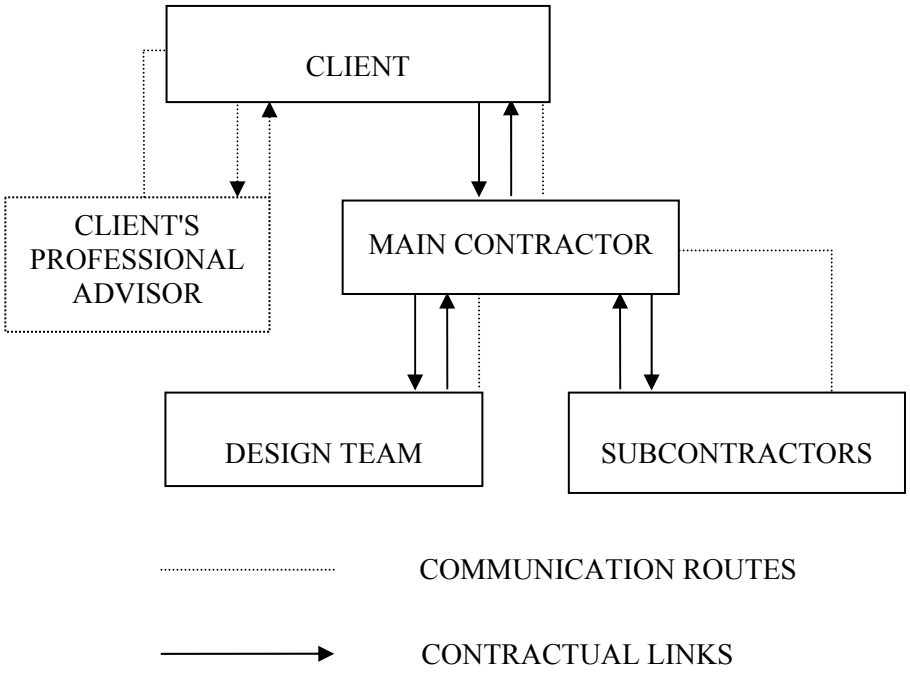


Figure 2.4. Typical Project Organization – Design and Build Method

While (Al Mansouri, 1988) found out that Saudi private sector clients were concerned with the negative impact on cost, schedule and reduced quality offered by D&B method. Rukneddine (1999) studied the cost aspects of the various contractual arrangements in Saudi. He discovered that Saudi clients were consistently concerned with the lack of cost control on projects and the lack of price certainty in D&B contracting.

Contrary to the above, a survey in Saudi Arabia by (Alhazmi and McCaffer 2000), indicated that the demand and acceptance of the D&B delivery system by the public sector has increased in the Saudi construction industry since 1999. Similar findings were confirmed by a study conducted by (Jaweed, 2004), who reported that D&B application in the Saudi construction industry is gaining more momentum in the private sector. This is due to the demand by these investors for faster delivery of projects and earlier time to market. The Local Oil and Gas company SAUDI ARAMCO awards most of its Petro-Chemical projects along D&B and the Construction Management options, MEED (Jan. 2005). **Table 2.5** summarizes the main advantages and disadvantages of this procurement option.

Table 2.5. The Design and Build Method, Advantages and Disadvantages

Advantages	Disadvantages
• One single point of responsibility to the Client. Less number of variations on site, fixed fee and fixed duration.	The creativity of the design, quality and aesthetics of the project maybe compromised due to speed of construction.
• Direct interface between the client and the D&B contractor and the nominated subcontractors (NS).	Little design and detailing effort and a noticeable level of repetition in the finished product.
• Work can start once the preliminary statutory approval is granted. No BOQ is necessary.	Client can not evaluate the other potential tender prices because tenderers may have produced different designs.
• Design and construction costs are negotiated together as one package and Client knows the cost at the early stage of the project. GMP is also included in the cost plan to limit and control the cost.	The Client must appoint a supervisor to over look the design and construction and administer the contract implementation.
• The contractor is liable for the design and construction defaults and liquidated damages in case of delays.	Client must clearly and accurately define all design requirements at the early stage or be liable to many costly variations.
• Earlier completion time and earlier recovery of cost since the project will generate income in a shorter time	Wrong decisions at the early stage prove difficult to rectify and may stay with Client forever.
• Can make this contract successful on sides, the client and the contractor.	Only contractors accustomed to design and build procurement can be considered for these delivery options
• Fair allocation of risk and reward. Where it's best able to be resolved.	Design changes become change orders
• It is a very good way to get complex, expensive projects done	Clients can be pushed for earlier and timely decisions.
• Simultaneous teamwork rather than fragmented work. Speed to completion. Change orders due to errors and omissions are eliminated since the correction of such is the responsibility of the D&B	Unfamiliarity with the process requires changing the corporate culture to a collaboration rather than adversarial
• The early involvement of builders on the D&B teams lessens the potential for design errors and buildability issues.	Barriers in procurement and licensing laws. Availability of insurance and bonding products for D&B.

2.8 Construction Management, (CM) Procurement

For Construction Management (CM) procurement, the client appoints an independent professional who has design and construction skills and experience that can assist the client to successfully manage the project through all stages. The client enters into a direct contract with each specialist trade contractor. The client utilizes a CM entity to

monitor and control design and construction compliance with the time, cost and quality standards.

In CM option, the interest is on saving time and money through a process wherein constructability is a key concern from the outset. The Construction Manager coordinates these contracts on behalf of the client and acts as his advisor. The contractual and organizational arrangements of this option are shown in **Figure 2.5.** Historically, the WWII building boom led to the creation of the CM procurement option in the United States. According to Beard *et al.* (2001), CM was introduced in late 1960's as a tool to overcome some of the problems associated with the D.B.B process. Murdoch and Hughes (2000) argued that CM came about when there was a need for large buildings to be erected quickly and reliably, coupled with increasing technical complexity.

The Saudi construction industry is quite familiar with the CM procurement option. A large number of public sector projects and major private sector projects engage the expertise of the CM in the project delivery. In fact, as argued by (Amjad,1998) during the late 1970's and early 1980's many large international construction firms and construction management firms had branch offices in Saudi Arabia. This included firms such as: Bechtel Arabia, Parsons Inc, of USA, Buro Happold of UK, Dumez, of France, Philip Holzmann, of Germany and J&P of Cyprus. In Saudi Arabia there is a distinct difference in CM services compared to other services around the world. The CM team assumes the role and duty of a site supervisor and advisor to the Client. The benefits gained included the earlier involvement of the constructor with the project, obtaining earlier knowledge of the project cost for budgeting reasons, and the ability of achieving proper quality control on site.

It is common practice in Saudi for the client of a major development to appoint a multidisciplinary site supervision team. This team manages and administers the construction activities (Amjad, 1998). Then an additional independent CM firm is also appointed to overlook the work of the contractor and the appointed supervisory consultant. The Riyadh King Khalid International Airport (1981-1985) was awarded to Bechtel Arabia using the construction management procurement path.

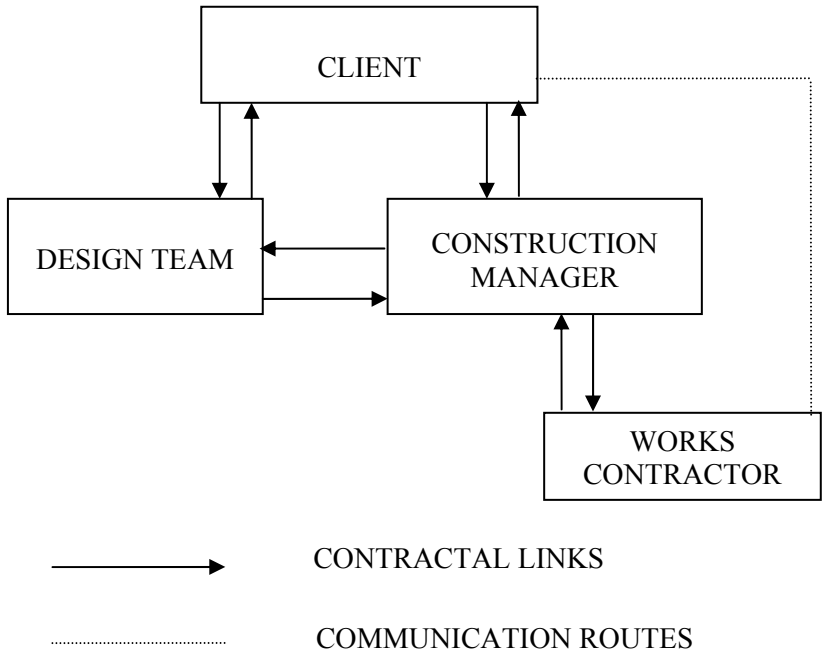


Figure 2.5. Typical Project Organization – Construction Management Method

King Saud University in Riyadh (1978-1982), the largest project to be built in Saudi Arabia with a student population exceeding 66,000, managed by HOK+4. The Kingdom Center, the tallest high rise mixed use building in Riyadh at 300 meter tall were awarded the construction management duties to Bechtel Arabia Gulf Construction (2001). In the Saudi construction industry, the duties and responsibilities that the CM handles include the following:

- Contract administration, cost planning and control.
- Overseeing the work packages, contractors' execution of the contract.
- Construction supervision, control and inspection of the works to ensure compliance of workmanship with the specified requirements.
- Testing and approval of samples. Quality control and safety control.
- Coordinate the work packages on site so that overlapping of various activities can occur with minimum interruption.
- Design implementation, and the interpretation of the design intent.
- Review the contractors' shop drawings, submittals and samples.
- Ensure proper incorporation of the client requirements.

Table 2.6 summarizes the main advantages and disadvantages of CM procurement delivery option.

Table 2.6. The Construction Management Method, Advantages and Disadvantages

Advantages	Disadvantages
• Earlier completion date with earlier income and less investment cost.	Clients are expected to be familiar with the construction industry. The burden of risk is with Client
• Efficient and experienced management team would plan, coordinate, organize and control all activities on behalf of the Client.	Any delay from one contractor would have a negative knock-on effect on the entire project. Failure to cope with change.
• Power and relationship structure in the bespoke contracts remain with Client. This will allow Client or their representatives, to manage the whole process and not the individual packages in isolation	Client will have to draft their own bespoke contracts for each specialist contractor and manage it directly. The absence of a main contractor will result in more work during the liability and defects period.
• Since the work is broken down to smaller packages the risk is reduced and the overhead is reduced as a result and the total cost in theory is less.	There would be a high cost to maintain the CM team. The cost will increase in case of a project over-run.
• Variation orders can be controlled and level of nomination is flexible.	Firm costs for the project are seldom known until later.

2.9 The Procurement Selection Process that Prevails in Saudi Arabia and the Perception of Saudi Construction Industry Stakeholders about the Use of D&B contracting.

Literature review reveals that for decades, the traditional D.B.B path dominates the Saudi construction industry. Al Sultan (1987) studied the Saudi construction projects duration and reported that Saudi clients choose the D.B.B system over D&B because D&B option has no clear contractual arrangements, offers no cost control, numerous claims, and many compromises to the construction quality. Al Mansouri (1988) compared the salient feature of the Saudi industry with the choice of procurement system in the United States and the UK. He studied the various perceptions of clients, contractors and consultants regarding the traditional D-B-B, Construction Management CM, and D&B delivery options. He studied what the consulting and contractors firms consider the efficient and productive approach. He identified twenty one 21 common contributory factors shown in **Table 2.7** that are shared between the consulting firms and the contractors. Their implementation would have a direct impact on the efficiency of the industry. Al Mansouri's findings revealed that the traditional D-B-B was dominating the industry. There was a wide variety in the way D&B procurement system is perceived and understood by both consultants and

contractors that influence the selection process. His study revealed the following opposing views between the consulting firms and contractors. The majority of the consulting firms surveyed were against the involvement of the contractors in the early design stage. These firms reported that the appropriate time for contractors' involvement should occur only after the completion of the detailed and construction documentation stage. Their reasoning was that:

> *"The earlier involvement of contractors could be risky and disturbing as contractors generally tend to simplify the design and influence the constructability of the project which in turn, will lead to higher financial profit".* (AL Mansouri 1988, 118-9).

Consulting firms prefer D-B-B and avoid D&B approach. They considered the D&B option to be risky. In contrast, the contracting firms surveyed favor being involved in the design process and welcomed its implementation. They asked for the current

Table 2.7. Factors that Affect Efficiency in the Saudi construction Industry.

1	Contractor's involvement in design		Need for fast track process.
3	Selecting the appropriate project delivery system.	4	Work packaging.
5	Responsibility for design and buildability.	6	Repetition of design activity (simplicity).
7	Awareness of available resources and materials.	8	Work place conditions.
9	Type of supervising firms and the nationalities of their staff.	10	Proper planning and scheduling.
11	Reduction of change orders	12	Using known construction skills
13	Having information about the site conditions	14	Prefabrication off site
15	Using rapid means to excavate	16	Overtime payment to staff
17	Rapid client decision making	18	Having trained CM or PM
19	Making regular progress payments	20	Having effective communication between contractor and PM
21	Having effective communication between all sub-contractors.		

Source: Al Mansouri (1988).

building and permit regulations to be changed to allow earlier start of construction on site using D&B delivery option.

Al Mansouri concluded that the Saudi construction industry is inefficient for many reasons which include:

- The separation of the design from the construction process.
- Inefficient project management structure and technique
- Lack of trust between contractors and consultants
- Design and Build contracting is only favoured by contractors who want to take short cuts in delivering the projects by reducing the design work and effort.

Ubaid (1991) studied the performance of contractors in the Saudi construction industry. He claimed that delays are expected irrespective of prior planning due to:

- Lack of trust between clients and contractors.
- Lack of proper project management tools.
- Presence of unrealistic contractual clauses that shift all risks to the contractors.

Jannadi (1997) continued the investigations. He reported that both contractors and clients are not carefully interpreting the scope of the project. This he argues, leads to adversarial and litigious relationships from the outset. Only twenty four percent (24%) of the design firms surveyed were willing to procure projects utilizing the D&B approach. These firms were unclear about insurance policies and liabilities of the architect and contractors working under D&B contracts. D&B option presents a venue with risk and thus is not fully explored. Jannadi continued, the public and the local professional institutions did not have enough examples to draw experience from, benchmark, and establish objectives for the new projects. Jannadi added that about twenty eight percent (28%) of the respondents stated that the D&B method forced design shortcuts producing fewer drawings, as they passed many design tasks to the subcontractors. Finally, twenty one percent (21%) of the respondents stated that they make uninformed design assumptions, over estimate requirements. These include space, structural and allocation of services. This is due to the perceived lack of a comprehensive design over-view.

Importantly, his findings reveal that forty six percent (46%), of the directors interviewed agreed that D&B is the preferable future procurement strategy. In time, it will become the new competing grounds. One director stated:

> *"The industry can not wait for further research. Booms are cyclical and do not last for too long. Integrated procurement delivery methods present a chance for the industry participants to procure projects in a timely manner and capture more work than planned for."*

Jannadi was very critical of the approach which is almost solely based on lower cost and speed to completion. He recommended that selecting the appropriate project delivery approach is equally important as selecting the qualified contractor. Amjad (1998) noted that the Saudi industry is well familiarized with the D.B.B but lacks a comprehensive, commonly accepted standard form of D&B contract. D&B does not have procedures for the application and procuring a project on D&B basis. Many clients devised their own bespoke form of D&B agreement, based on the FIDIC family form of agreement Amjad (1998). Assaf *et al.* (1995), studied the causes of delay in large building construction projects in Saudi Arabia. They revealed that D&B was never accepted as an alternative to the traditional approach because there was little shared knowledge about this option. Also Saudi clients were not prepared to accept dealing with contractors as designers. A fundamental assessment and criticism of the attitudes and cultural perceptions of the contracting current methods are required before the introduction of an alternative contracting method other than the traditional D.B.B method.

Al Khalil and Al Ghafly (1999) studied the delay in a public utility project in Saudi Arabia. They claimed that delays are an accepted phenomenon within the industry. The industry needs to rethink and reconsider many of these accepted terms that have been taken for granted for decades, including the use of the traditional D.B.B system. Abdul-Hadi *et al.* (2005) called for the Saudi construction industry to re-engineer itself to achieve simpler cost control and for better coordination and integration.

A working procurement selection system for Saudi Arabia came from Alhazmi and McCaffer (2000). They developed a Project Procurement System Selection Model (PPSSM) **Figure 2.6, Figure 2.7,** and **Figure 2.8** respectively. They conducted a survey in Saudi Arabia aimed at testing this PPSSM for effectiveness and efficiency. The method assists the Saudi governmental agencies in selecting the most

appropriate procurement system for implementing their projects. This model integrates the techniques of the analytic hierarchy process with Parker's judging alternative technique of value engineering into a multicriteria, multiscreening system. This model is structured to examine the relationship between different procurement systems with reference to six criteria:

- Project characteristics
- Market attributes
- Contractor and architect/engineer (A/E) needs
- Categories of clients
- Client design organization
- Local design and construction regulations.

In this framework, clients' needs are grouped into four categories: Cost, Time, Quality, and General Needs. Procurement systems are classified according to the integration of the design and construction management. The PPSSM creates a comprehensive methodology for the selection of the most appropriate procurement system. It comprises four screening levels. The first three screens are part of Parker's technique and the final screen uses Saaty's Analytical Hierarchy Process (AHP) evaluation method. This model was designed to require an effective decision making technique to systematically evaluate procurement systems against a number of criteria. It cause the project team to separate needs from desires, the important from the unimportant, and trade-off from non-trade off items. The model runs from the first rough screening process to the most detailed fourth screening. In each screening stage, potential procurement systems are subjected to evaluation prior to their selection for further analysis.

- The first screen is concerned with Feasibility ranking. It develops a set of evaluation criteria used to judge the competing procurement systems for feasibility as shown in **Figure 2.7.**
- The second screen performs an evaluation by Comparison as shown in **Figure 2.8.** Here the comparison of feasible procurement systems is made by listing the advantages and disadvantages of each. All of the good points for each procurement system are listed as well as the bad points. The purpose of the screening is to provide the opportunity to maximize the benefits of each procurement system while, at the same time, minimizing the drawbacks.

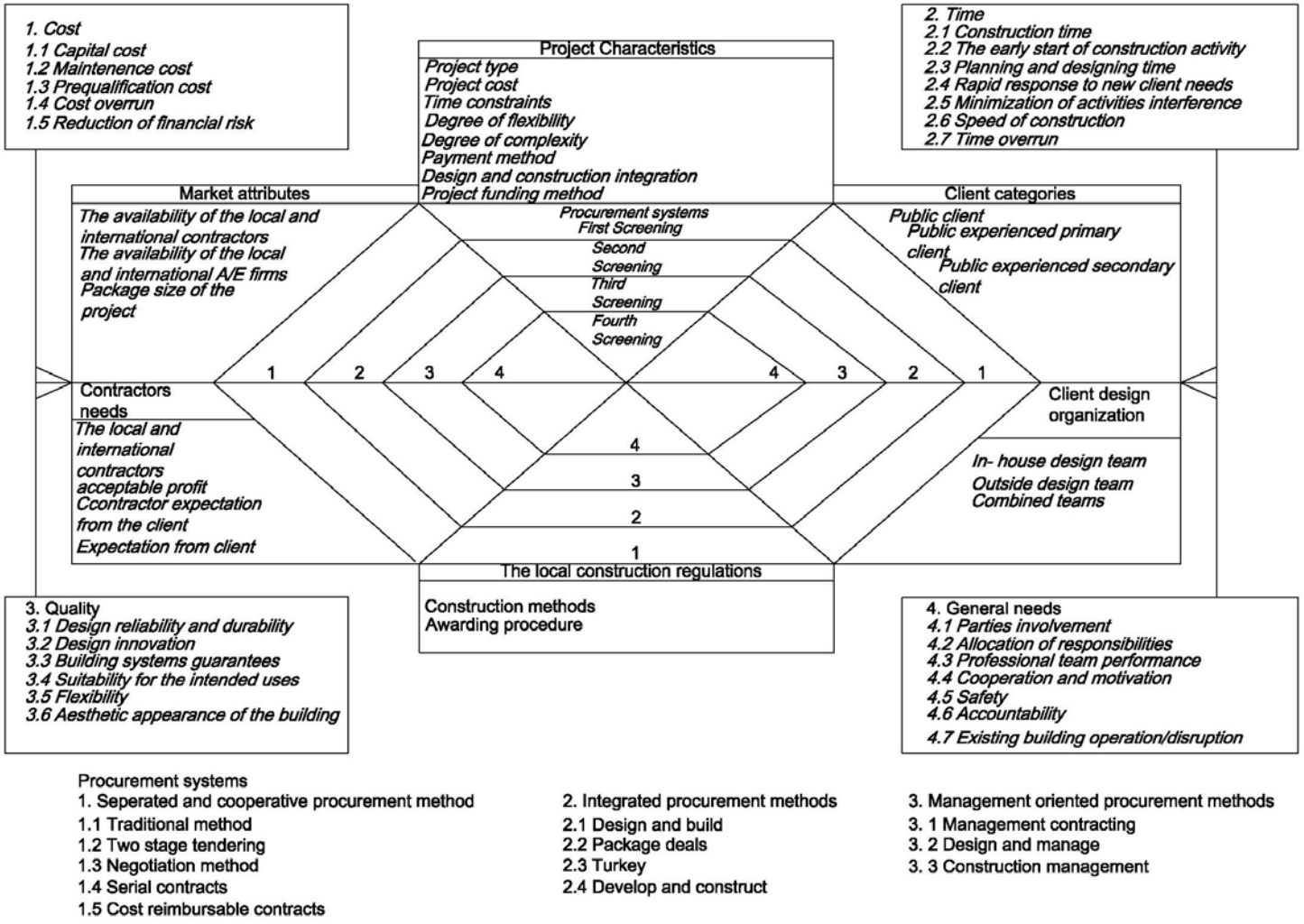


Figure 2.6. Project Procurement System and Selection Model

Source: Al Hazmi and McCaffer (2000)

SCALE OF ASSESSMENT
(1)

4 -Extremely appropriate
3 - Very appropriate
2 - Moderately appropriate
1 - inappropriate
0 -Extremely inappropriate

PROCUREMENT SELECTION CRITERIA
(2)

1. PROJECT CHARACTERISTICS

Procurement systems	Project types	Offices	Residential	Project size	Large size project	Normal size project	Project cost	High cost project	Medium cost project	Low cost project	Degree of flexibility	Flexible scope of work project	Fixed scope of work project	Degree of complexity	High specialized technology	Normal Technology needed	Time constraints	Curcial	Important	Not important	Payment methods	Lump -sum	Fixed fee	Persentage Fee	Unit price	Design/construction integration	Highly needed	Not needed	Project funding methods	Government funded projects	Private funded projects
1. Separated and cooperative procureemnt method																															
1.1 Traditional Method																															
1.2 Two stage tendering																															
1.3 Negotiation method																															
1.4 Continuity contracts																															
1.5 Serial constracts																															
1.6 cost reimbursable contracts																															
2. Integrated procurement Methods																															
2.1 Design and build																															
2.2 Package deals																															
2.3 Tumkey																															
2.4 Develop and construct																															
3. Management oriented procurement methods																															
3.1 Management contracting																															
3.2 Construciton management																															
3.3 Design and manage																															

Figure 2.7. The Feasibility Ranking

Source: Al Hazmi and McCaffer (2000)

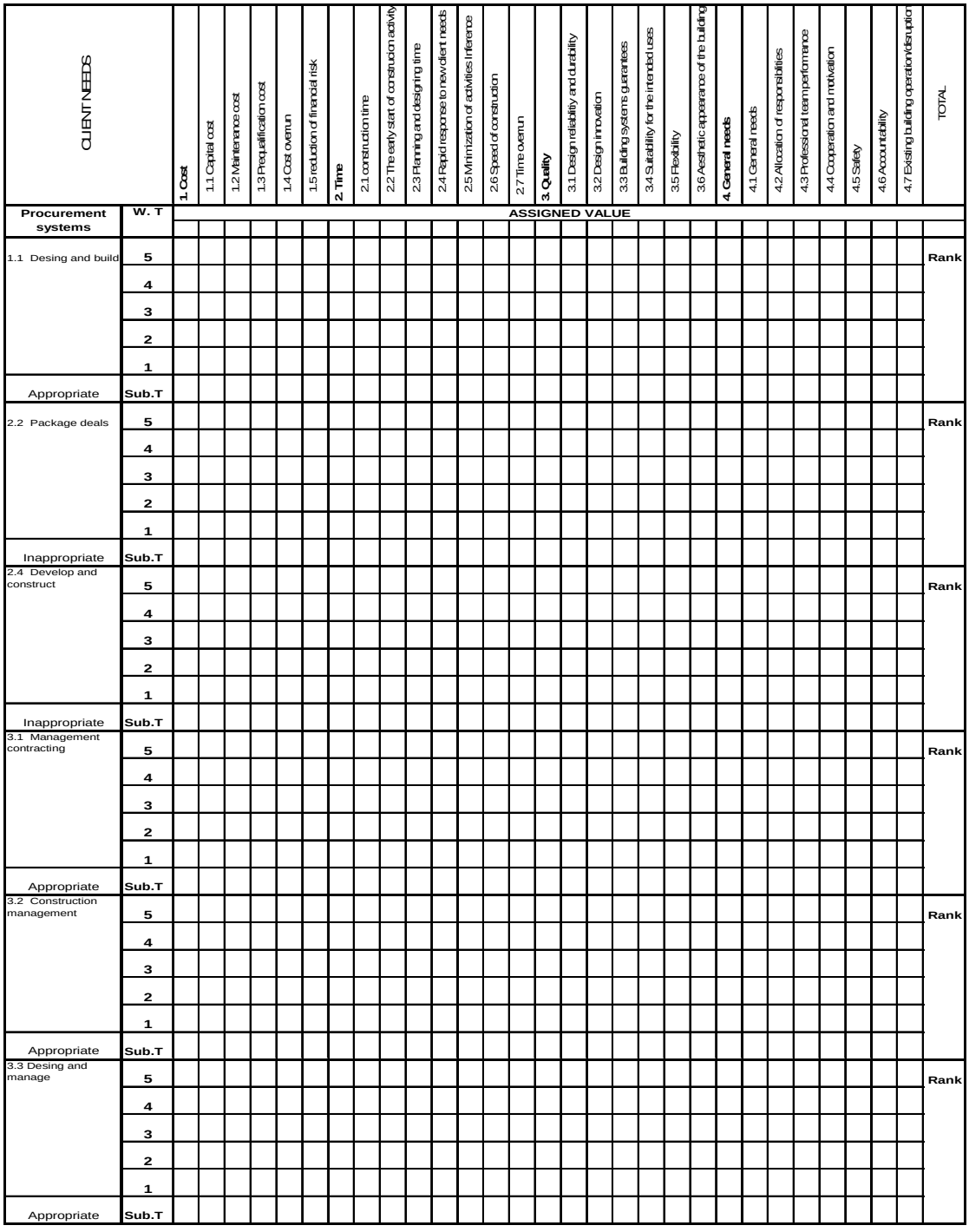


Fig 2. 8. Evaluation Matrix

Figure 2.8. The Evaluation Matrix.

Source: Al Hazmi and McCaffer (2000)

- The third screening stage is a weighted Evaluation. A weighted evaluation process is used to identify the optimum procurement systems. The factors considered to be most influential in the selection process are referenced. This technique is employed to bring more objectivity to subjective decision making. A paired comparison and matrix analysis are performed in two stages. In the paired comparison one need is compared only with one other need at a time. This identifies those needs with greater value and importance. The Evaluation matrix will show the client's needs and their weight in evaluating the procurement systems surviving from the first two screens.
- The fourth screen conducts a computerized Decision support. Software is used such as Expert Choice V 9.0 to structure the PPSSM based on the evaluation method using Analytical Hierarchy Process (AHP). The six factors affecting the procurement system selection are classified into categories and inserted into level one of the model to serving as the main criteria.

The survey results showed that Saudi Public sector clients consider D&B option as the most appropriate procurement system for their project.

Another D&B procurement implementation model was developed by (Jaweed, 2004). This model identifies factors affecting the selection of D&B contracting. It developed a software tool model with guidelines for the implementation of D&B method as shown in **Figure 2.9.** Jaweed's model was based on seven distinct phases that would guide clients, contractors and concerned industry participants to decide if D&B is the appropriate procurement method.

Phase One of the model is concerned with establishing a number of criteria related to the nature of the facility being proposed for D&B. These criteria include:

1. Project characteristics 2. Owner Requirements
2. Applicable market sector 4.Previous constructed design facilities

At this very early stage of the project life cycle clients can decide whether the D&B project delivery option is the appropriate contracting strategy. Details of each component of these project and client factors are shown in **Figure 2.10.**

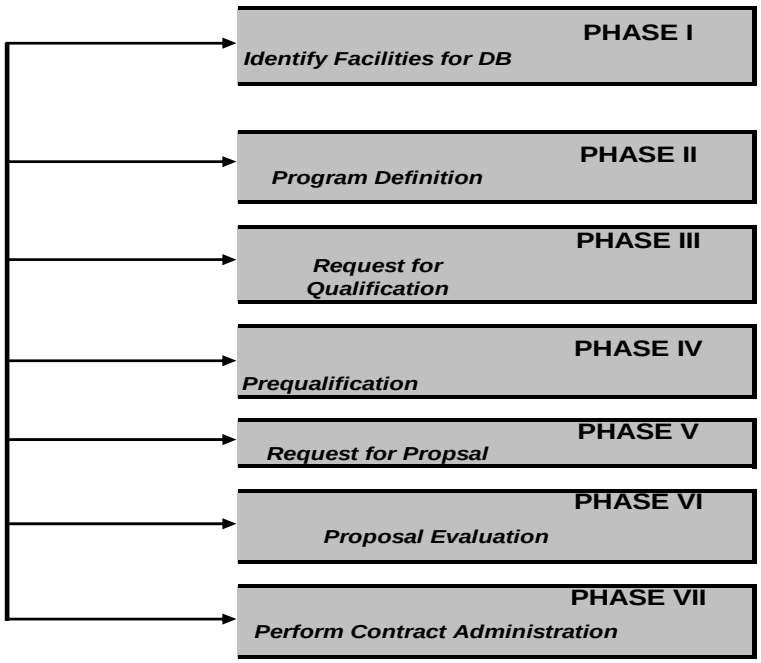


Figure 2.9. Design and Build Selection Model

Source: Jaweed (2004)

Project Characteristics

The first criteria addresses general project related features that warrant the selection of D&B. The features are wide ranging and include project size, risk involved, complexity of the project, its location and constructability challenges.

Owner Requirements

Owner Requirements addresses the desire of certain clients to contract with one entity in order to save time in tendering and administration of design and construction, cutting cost by accepting the involvement of the contractor in the design process from the outset, production of less detailed drawings benefiting from the contractor's knowledge, having a guaranteed construction sum with little anticipated claims and variation orders from the outset, and promote innovation in design. These are features that would assist clients to decide on the feasibility of choosing this delivery system.

Applicable Market Sectors

Certain projects could be prime candidates for D&B procurement such as utility projects, power houses, military installations, processing plants, and infrastructure projects. These project types can be well defined by performance specifications in contrast to prescriptive predefined specifications. These projects can be described to comply with statutory and industry standards. Therefore, they stand a great chance for being selected to be procured along the D&B method.

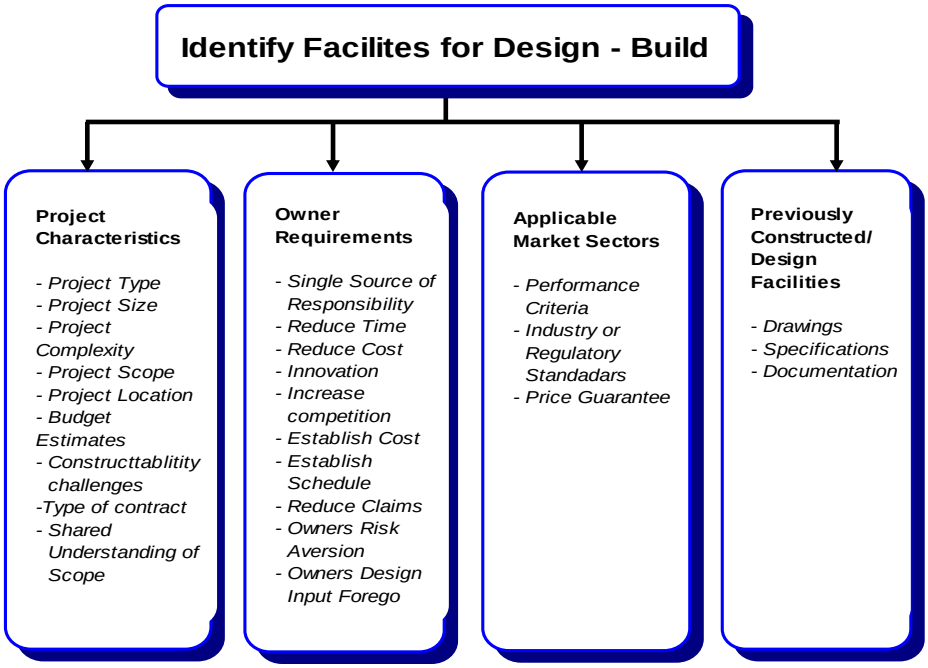


Fig. 2.10: Phase I, Selection Process, for D/B- Jaweed (2004)

Figure 2.10. Phase I Selection Process for D&B Option

Source: Jaweed (2004)

Previously Constructed Design Facilities

The successes and failures of D&B method based on the track records provide valuable information to ascertain the choice for or against D&B approach. Beyond this phase, the model provides guidance to successfully implement D&B and work closely with the supply chain. Further research areas were referred to in this study.

It specifically invites the legal authorities to give seminars aimed at providing training for the concerned industry participants about the D&B option. The issue of training reported by (Jaweed, 2004), was previously raised by Amjad (2003), who investigated the effects of professional training in the Saudi construction industry. According to him, Saudi graduates did not have the necessary training and experience to select the appropriate procurement strategy including alternative methods other than the traditional D.B.B path. Equally important, Amjad, added:

> *"A substantial amount of public money is being wasted annually due to the lack of trained professionals in the country in charge of running public sector construction projects. The Saudization program is also impeded due to the non availability of qualified Saudi professional".* (Amjad 2003, 233)

The importance of having trained and skilled project managers was recently highlighted by Isik *et al*. (2009). They advocate that a key factor for the successful completion of a project is the appointment of skilled project managers, adequate planning of the project adequate information flow, rewarding the employees, and being open to innovation.

The Al Hazmi McCaffer's model offers the client the choice among three procurement systems. The model tests six design and construction criteria: project characteristics, market attributes, contractor and architect engineer needs, categories of the client, client design organization and local design and construction regulations against four client's needs grouped into four categories: cost, time, quality and general needs. The clients will trade-off the needs from desires through the four screening in order to eventually establish the optimum procurement option.

In Jaweed's model, D&B client have to identify the suitability of the D&B projects by examining four criteria related to: project characteristics, owner requirements, applicable market sectors and previously constructed D&B facility. Both project procurement selection models are aimed at assisting D&B client choose the optimum procurement option. However, Al Hazmi's McCaffer's model requires careful assessment of other client's needs and how they overlap with the six criteria. Jaweed's model goes further

and defines seven distinct phases that the D&B clients have to consider from identification of the D&B facility to performing the contract. A software is also provided to guide the client through the whole process. By comparing past studies it is apparent that these researchers acknowledge the existence of the problem within the industry. They further agree that although D&B method is not commonly practiced yet, it can potentially offer solutions to the problems that the industry is experiencing. Past studies that identified the inefficiency of the Saudi construction industry and areas needed for improving the process of selecting the appropriate procurement method including D&B are summarized in **Table 2.8**. Therefore, based on the literature review the proposed solutions to the adoption of D&B contracting must address areas of common concern including its viability. Local perception of D&B is that it appears to be a mix of techniques and methods without any strong scientific foundation to build upon.

Table 2.8. Summary of Previous Major Research Regarding Areas where Improvements are Needed in the Procurement of Projects and the Introduction of D&B Method in Saudi Arabia Construction Industry

	Define Project Characteristics	Establish Project Procedures	Project Management Strategies	Acceptance of Joint participation	Project Work Atmosphere	Improve knowledge and awareness about D&B	Separation of Designer and contractors	Redefine contractual procedures	Remove cultural Barriers
Saudi Chamber of Commerce Real Estate Conference (2007)			√		√	√			
Al Saudi (2005)	√	√		√	√	√		√	√
Jaweed (2004)	√	√			√	√			
Amjad (2003)			√		√				
Alhazmi and McCaffer (2000)	√	√		√				√	
Al Khalil & Ghafry (1999).		√	√	√		√			
Jannadi (1997)	√		√				√	√	
Amjad (1998)			√		√		√	√	√
Assaf et al. (1995),			√						√
Al Barrak (1993),		√		√	√			√	
Ubaid (1991)		√					√	√	√
Al Mansouri (1988)				√		√	√		√
Alhazmi (1987)									
Al Sultan (1987)		√		√	√			√	
Al Jarallah (1983)		√		√	√				√

2.10 Summary

This chapter presented a brief historical description of the evolution of the Saudi construction industry from the early 1970s to the present. It explained the procurement process in general and the importance of selecting the appropriate delivery option for each specific project in order to obtain the optimum cost, time, risk aversion and level of quality. The commonly used procurement strategies in the Saudi construction industry were discussed. These include:

- The Traditional D.B.B system.
- Design and Build.
- Construction Management.

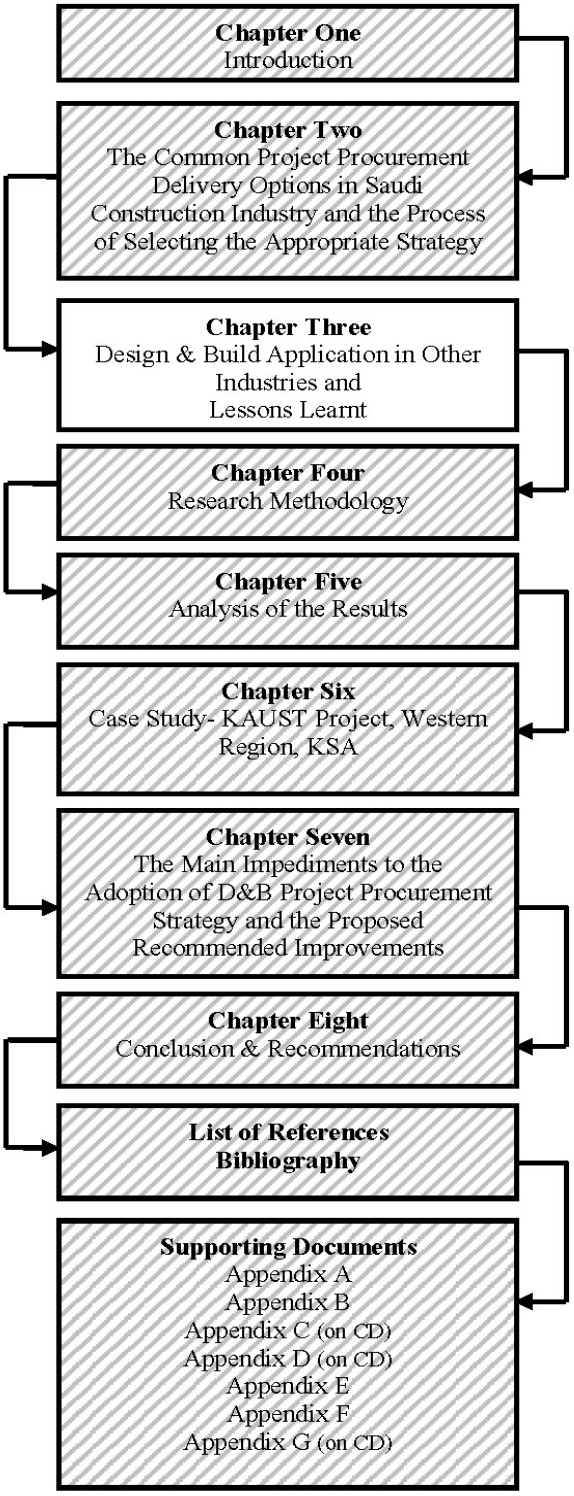
The Traditional D.B.B system offers the client more control of quality and cost with clear lines of responsibilities. But it tends to elongate the project time line. Saudi clients and consultants were found to favour this project procurement option.

The Design and Build principle of single point responsibility provides the client a greater degree of resolution and clarity of risk allocation and contractual responsibilities. It can shorten the project delivery schedule and save costs. It was criticised for lack of innovation and considered risky by Saudi clients and consultants.

Construction Management is considered ideal for large complex projects where there is likely to be a number of specialist trade suppliers, working on the project at the same time. With this option, the client is exposed to considerable risk.

D&B contracting is not a new concept in the Saudi construction industry and has, in fact, found limited use by many public sectors since the 1970s. However, the traditional D.B.B contracting option has been predominant in the Saudi construction industry. Previous studies highlighted the cultural barriers that encourage the separation between consultants and contractors. The Saudi construction industry does not appear to have a common definition of the D&B delivery option. Two serious attempts were made in Saudi Arabia in the year 2000, and again in (2004), to devise a project procurement selection systems and implementation model for D&B. The next chapter extends the literature review and discusses what is known about D&B project procurement system, its successful implementation in many other industries.

Chapter III
Design & Build Application in Other Industries and Lessons Learnt.



3.0 Introduction

This chapter extends the literature review, studying the international knowledge of the Design and Build (D&B) project procurement delivery option. It focuses on its origin, evolution and context of the construction industry today. The various contractual arrangements that govern its application are reviewed, explaining its eventual institutionalization as a recognized project procurement option. The opinions and views, as argued by various industry participants, academics and researchers are enumerated. The improvements of the construction industry to accommodate D&B are examined, as well as, criticism, arguing the draw backs and pitfalls that challenge its validity. Chapter Three also examines the application of D&B concept in other industries such as; the manufacturing, digital and automotive industries. A comparison of industries perceptions and successful application of this delivery option is given. These industries have been able to shorten the new product development time and continuously improve the quality of their products. The local perception and operating environment regarding D&B option is also presented

3.1 What is known about Design and Build (D&B) A Historical Perspective

The D&B concept has its roots in ancient civilizations. It can be traced to the designed and built cave man shelter. According to [Bower 2003, Beard, *et al.* 2001, Turner 1997, Friedlander 1998, DBIA 1994, McManamy 1995], the earliest form of infrastructure delivery involved a Master Builder serving as both project designer and builder. Throughout recorded history, this project delivery has developed major projects including the Pyramids, Temples, Aqueducts, Cathedrals and major religious public buildings, [DBIA 1994, Chan *et al.* 2001, Molenaar *et al.* 1999, Deakin 1999, Jaweed 2004, Tianji *et al.* 2005, Tulacz 2006].

Citing Dixon (1988), Beard, *et al*. (2001), reminded us that the earliest known design document for a building is a plan on a stone tablet from 2900BC. The Code of Hammurabi (1800BC) in ancient Mesopotamia fixed absolute accountability to "Master Builders" for both design and construction, (Engdahl, 2003), (DBIA, 1994). The Master Builder approach designated sole source responsibility having absolute accountability for both design and construction. Master Builders of classical Greece

were engaged to both design and construct their great temple, public buildings and civil works, monumental structures.

Master builders accepted full responsibility for integrating conceptual design with functional performance (Beard, *et al.* 2001). Throughout each massive logistical undertaking they commanded skilled craftsmen, procured materials, and controlled every aspect of the project. The master builder was the chief architect, engineer and builder moulded together with complete accountability for delivering a project (DBIA, 1994). Enduring structures such as the Parthenon and the Coliseum are testimony to an age and a process that are greatly admired. It is a reality carved in stone. The Seven Wonders of the World stand as stunning testimony to the design build process. In the absence of engineering principles, standards and specifications, the Master Builder alone had the experience and understanding of fundamental techniques and construction principles to build (DBIA, 1994).

Typically, Master Builders passed on their specialized skills and knowledge from one generation to the next, gradually enhancing their profession through the development and application of new techniques, often based on empirical trial and error, (Lam *et al*. 2004). By integrating these two sequential and highly independent phases of project development, the early design-builders adjusted the design to fit prevailing site conditions and to take advantage of new techniques or alternative sources of materials. The D&B approach was essential in building all the prehistoric structures. They were built as relatively organized endeavours. As stated by (Beard *et al.* 2001, DBIA, 1994) the D&B delivery concept and its practice is ancient, however its formal studies and application is relatively new.

3.2 Division of Design and Construction Institutes

The knowledge and skills involved in project design and construction became increasingly complex during the Renaissance in Europe. Better documentation and a more specialized approach enabled the design function to become distinct from the construction functions (Turner 1997, Songer and Molenaar 1997). Along with the increased complexity and specialization came concerns over the accountability and responsibility of the various functions that comprise the project development process (Beard *et al.* 2001, McManamy, 1995). Mounting concerns over the objectivity, favouritism, integrity and manipulation of the process which could lead to fraud,

waste, and abuse in the development of large infra-structure projects, government agencies in the USA instituted contracting reforms late in the nineteenth century. These reforms culminated in the development of the two-step project delivery process known as the Design-Bid-Build, (D-B-B), (AIA 2003, DBIA 1994). The owner commissions an architect or an engineer to prepare the drawings, bills of quantities and specifications, under a design services contract. Subsequently, a construction contractor is selected by competitive bidding or negotiations to build the facility under an "at risk" construction contract, [Turner 1997, Murdoch and Hughes 2000, Beard *et al.* 2001, DBIA 1994]. According to (Cox and Thompson 1998), the D&B delivery concept cuts across the fragmentation created by professional institutions. This option adds Beard *et al.* (2001), was the choice for project delivery for most of the 20th Century throughout the world.

3.3 What Is Design and Build Project Procurement Delivery System in the Construction Industry

There are a wide variety of ways in which projects can be procured and delivered. Some, including D.B.B, segregate the roles and responsibilities for the different phases of the project. The final design is completed by one party using a negotiated contract and the subsequent construction is awarded to a separate contractor, usually the low-bidder. Others integrate the design and construction activities under a single overall contract, as with D&B contracting. Still others extend contract roles and responsibilities far beyond project development to include operation, maintenance, preservation, and even finance, (Tianji *et al.* 2005, Beard *et al.* 2001, Friedlander 1998). Each delivery option has characteristics that are suitable to a specific client's priorities and needs, (Anumba and Evbuomwan1997).

The proper use of the D&B concept has been debated. There seems to be a unanimous interpretation of D&B as the process of providing design, construction and contract administration services under a single contract. These services are performed by one company, firm, or a group of individual firms who form an association or joint venture that is recognized as a legal entity. This entity may be led by a contracting firm, as commonly the case, (Murdoch and Hughes 1999), or a designer. The D&B entity agrees to design and build, refurbish or upgrade a project, as described in a Request For Proposal (RFP) document issued by the client. The design and construction activities are integrated into one contract awarded on either a

low bid or best value basis. This is in marked contrast to the traditional (D-B-B) approach in which two separate efforts are undertaken in sequence [Tulacz 2006, Knight *et al*. 2002, Chan *et al*. 2001, Beard, *et al.* 2001, Molenaar *et al.* 1999, Murdoch and Hughes 1999, Deakin 1999, Cox and Thompson 1998, Anumba and Evbuomwan, 1997, DBIA 1994].

Several industry institutes, researchers and practitioners have defined the salient features of this D&B form of project delivery, (which is also known as Design/Construct) delivery including (AIA 2001, DBF 1997, DBIA 1994). With D&B approach, the design builder warrants to the contracting party or the client that it will produce design documents that are complete and free from error and the design-builder will take the associated design and construction risks. The D&B entity can assume several organizational structures. Most common would be:

- A firm possessing both design and construction resources in-house.
- A Joint Venture between designer and contractor.
- A contractor led team with the designer in a subcontract role.
- A designer led team with the constructor in a subcontractor role.

During the past three decades, according to (Sell, 2003) the use and interest in D&B contracting in the USA and UK has greatly accelerated, becoming one of the most significant trends in the design and construction industry. D&B has gained attention, because owners, including government agencies, found it attractive for complex projects. It reduced project time, eliminated major gaps in building a project. For some owners, integrating project delivery offered a convenient and efficient single responsibility for the entire project. This potentially leads to favourable cost results. Competing on time, as argued by (Hamel and Prahalad 1996) was also a huge advantage to many D&B clients. For the last two decades, the UK construction industry has been under pressure to improve its performance and productivity. In response, the Construction Client's Forum (CCF) and Construction Round Table (CRT) were formed. Two major reviews were carried out by Sir M. Latham "Constructing the Team" (1994) and Sir J. Egan (1998) "Rethinking Construction". These reviews identified the problems that caused bad performance, poor image, high rate of insolvencies, and low profitability in the industry. The recommendations included a change in the current contractual relationships from D.B.B to D&B

options to enable delivery of projects on time, on budget and to the stipulated quality level.

Sir Eagan (1998) asked the construction industry stakeholders to radically improve the current application of project management, to partner with the supply chain, to explore new techniques including, standardization and off-site production, and to benchmark its performance against other industries. Both reports stressed the importance of permitting an earlier start and completion of projects, exploring ways to reduce and eventually eliminate waste, making the project procurement process concurrent and more integrated, leaner and more efficient. They highlighted the need to innovate with new methods of contracting and delivering projects. Lam *et al.* (2004), Koskela (1997) advocated the importance to benchmark to other industries. There is much to be learned from the automotive, manufacturing and aviation industries. The various stages in the D&B contracting approach as defined by (AIA, 2001) are illustrated in Figure 3.1. Bennett *et al.* (1996) defined D&B as an integrated project delivery process that offers a holistic approach to building in which all project participants, architects, engineers, contractors, project managers, supply chain and owners work together. Gidado and Arshi (2004), Molenaar *et al.* (1999) described D&B contracting as the arrangement where one contracting organization takes sole responsibility, normally on a lump sum fixed price basis, for the bespoke design and construction of a client's project. The work environment is highly collaborative. It strengthens work relationships at all levels, fosters innovation, creativity, and a sense of unity in purpose among participants. Masterman (2002) argued that this definition contains three fundamental characteristics, namely:

1. The responsibility for the design and construction lies with one organization.
2. Reimbursement is generally by means of fixed price lump sum.
3. The project is designed and built specifically to meet the needs of the client.

Critics of the D&B project delivery argue that D&B contracting, in many cases, is proposed as the answer to the failure of the original planning and scheduling of projects, (Oztas and Okmen 2003, Kerzner 2003, Cramer 1994, Tighe, 1991). Friedlander (1998) argued that despite its growth in popularity, the D&B process creates obstacles with risk and insurance challenges since most of the laws and work assumptions are based on the traditional D.B.B contracting option.

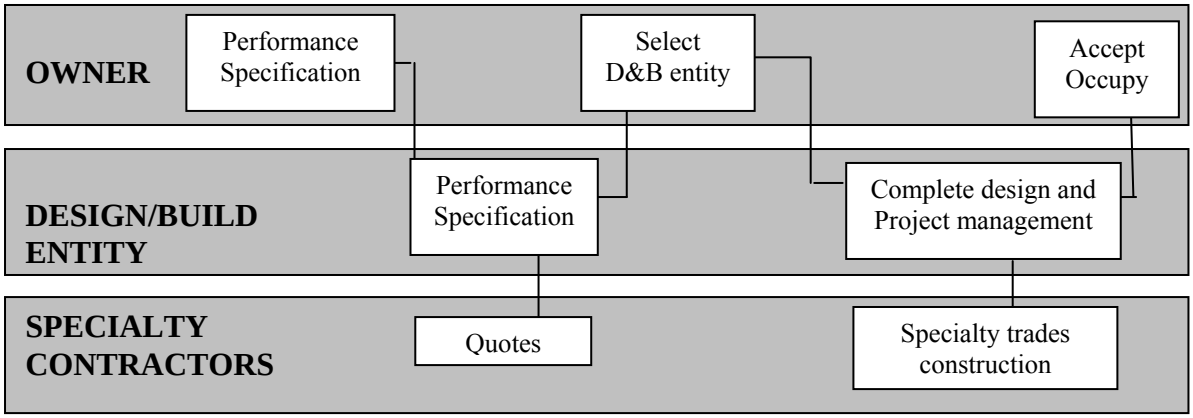


Figure 3.1. Design and Build Approaches,

Source: AIA, (1995)

Today's business climate is different. It is characterized by unprecedented changes in technology and global competition. Faster, cheaper and better is a state of mind. Delays in completing a project can mean loosing a future opportunity. The continuous change of the global economic conditions necessitates researchers, government and professional institutes to explore new methods of procuring projects efficiently.

3.4 Types of Design and Build and the Contract Award Selection Process

Research has shown that there is an increase in the use of D&B over the last 20 years. Lindsey (2003), reported that the value of contracts using Joint Contracts Tribunal (JCT) D&B form in the UK has doubled since 1995. The selection process can take several forms ranging from a direct appointment to competitive bidding, comprised of a two- step proposal with two main variants. Several writers, authors and government agencies including [AIA 2001, Tenah 2001, Anumba and Evbuomwan 1997, Songer and Molenaar, 1996, DBIA 1995] have described some configurations of D&B contracting that have evolved over the past three decades. These variations include:

- Direct D&B with complete responsibility for design and construction.
- Comprehensive Turnkey contracts with D&B contractor taking full charge of acquiring the land, financing and constructing the project.

- Design and Manage. Where the contractor is compensated for managing the design and construction activities while retaining the design responsibilities.
- Design, Manage and Construct. Which is similar to the design and manage variant with the contractor involved in the construction activities.
- D&B with novation of client appointed architect.
- Develop and Construct. This involves the contractor developing the scheme design prepared by the client's architects to detailed design and performs the construction activities without the novated design architect.

Pain and Bennett (1988), identified four ways of organizing D&B contracting, whereas (Gidado and Arshi 2004, Akintoye 1994) have identified six variants. The most commonly used D&B award methods are the direct negotiated process and competitive bidding with warranty and paid stipend paid for all participants.

3.4.1 Direct negotiated process.

For this form of D&B contract, the client negotiates with one contractor to design and construct the required project. This type of contracting is based on an established and successful work relationship. DBIA (2001) reported that this is ideal for certain complex and complicated projects with specific technology application, as in the case of power stations, processing labs, and highly technical installations. The nature of these projects mandates with slight exception that the client commission directly the D&B entity to control the installation of proprietary items.

3.4.2 Competitive Design Build Process

This competitive process according to (AIA 2001, Beard *et al.* 2001, DBIA 2001 Anumba and Evbuomwan 1997), involves several contracting firms who express interest in bidding a project. In most cases, the client prepares the outline design with performance specifications stating the main objectives and value system. The outline design can be done either "in-house" or by appointing an independent consultant who will develop the project's scope of services for the tender. Depending on the size, duration and complexity of the project, and in an attempt to limit the number of tenderers, some clients approach this procurement method in a two-phase selection process. The first phase prequalifies a short list of capable D&B entities based on a combination of qualitative criteria as explained below:

- Team structure, experience and management plan.
- Technical capabilities, core competencies.
- Track record and reputation.
- The time needed for performance of the contract.
- Innovative design approach, aesthetics.
- The scope of the quality of work.
- Work management, Project control.

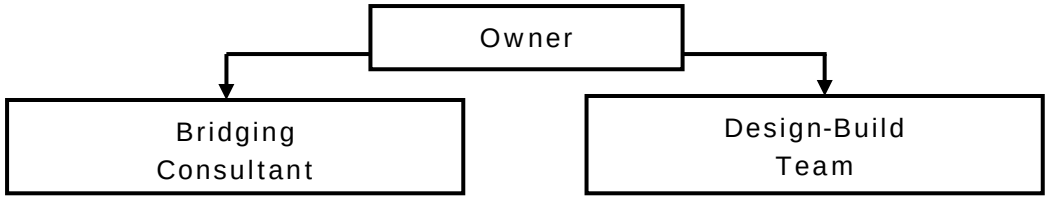
The above objective parameters for the best value criteria are part of the qualitative submittal required from each bidder. It is important to note that the criteria include factors that are not directly convertible to cost. The client then issues a Request For Qualification (RFQ) letter describing the project in enough details for potential proposers to determine if they wish to compete.

For the second phase, complete D&B proposals are submitted from the pre-qualified or short listed offerors. This stage is also referred to as the "two envelope" process. Qualitative proposals are submitted separately from price proposals. The price proposal remains sealed until qualitative proposals are evaluated. The final evaluation of the bids is based on allocating value points for the qualitative criteria and value points for the technical and financial offer. This is a form of a best value selection. The project is awarded based upon the highest total weighted criteria points earned by the proposers from both stages. According to (DBIA 1994), this best value approach came after the 1972 Brooks Architects-Engineers Act in the USA. The legislation required all design contracts for federal capital projects be awarded on qualifications and not low bid. The two main variations to this competitive bidding include:

- Novation Design and Build
- Develop and Construct

For novation D&B, the selected D&B entity is obliged to retain the client's designer to develop the complete detailed design and to oversee the construction activities. They ensure that the client's implied and explicit requirements are fulfilled. This approach has caused some disputes and conflicts of interests according to (Tenah 2001, Gidado and Arshi 2004). Chitwood, (2003), Friedlander (1998), described another change within this variant which he called the **"**bridging**"** as shown on **Figure 3.2.** Bridging, according to Chitwood, occurs when the client appoints a

design professional or a design criterion professional who develops the preliminary design to maximum of 35% completion, including a set of performance specifications.



Project Responsibilities

Owner	Bridging Consultant	Design-Build Team
Determines Project Scope	Prepares Program	Architect prepares contract documents
Selects bridge Consultant	Develops conceptual drawings (approximately. 30%)	Contractor receives sub-bids and constructs facility
Develops budget	Prepares RFP for design- build firm	

Figure 3.2. The Role of a Bridging Consultant
Source: Chitwood, (2003).

These performance specifications are expressed in terms of an expected outcome or acceptable performance standards often used in D&B criteria to articulate the owner requirements. The use of a bridging consultant, as argued by Chitwood, satisfies many needs in D&B project procurement strategy. Tulacz (2006) argued that control over the basic design is critical for some clients who are concerned with the quality of the design. Following this stage, the successful D&B entity takes over the project and prepares the complete detailed design and construction drawings. The design criteria architect remains as a client representative coordinating the proper progress of works with the D&B entity. The Develop and Construct variant allows the successful D&B entity to develop the client's preliminary design to an acceptable level and then proceeds with the construction activities.

3.5 Available Design Build Contract Documents

The construction industry has several D&B contract documents in circulation. The AIA has published several documents including the D&B Form of Agreement that provide a benchmark for the industry. AIA family of contracts AIA (2003) reported that for the last ten years the AIA D&B contract documents were the most widely

sold D&B documents in the industry. DBIA (2001) published a manual of practice document which includes illustrations guiding the requirements and deliverables expected under the Two Parts contract as shown in Figure 3.3. This manual defines the multiple phases of delivery for process industry best practice. Several professional associations publish standard forms of agreements, including forms for D&B projects. These include:

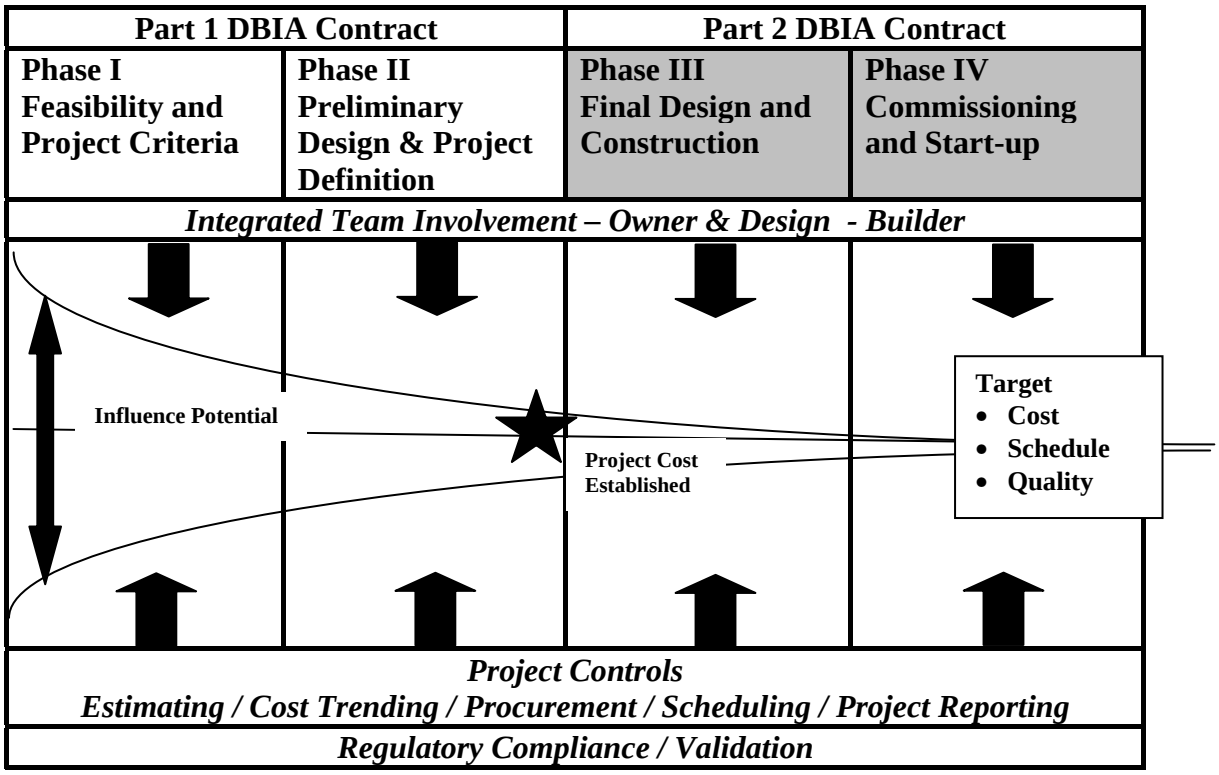
- The Associated General Contractors of America (AGC)
- Design Build Institute of America (DBIA)
- Engineers Joint Contract Documents Committee (EJCDC).
- International Federation of National Associations of Consulting Engineers (FIDIC).
- The Canadian Construction Documents Committee (CCDC).

FIDIC is the most commonly used form of contract in Saudi Arabia, (Jaweed 2004, Jalauddin 2001, Jannadia *et al*. 2000). However, it is common practice for Saudi clients to introduce several amendments and changes to the original FIDIC documents (Amjad, 1998).

3.6 The Perception of Construction Stakeholders about the Need for New Innovative Project Delivery System Such as D&B Option

Considerable research, debate and studies have demonstrated the advantages, and disadvantages of D&B delivery system. These efforts as pointed out by (Solis 2009) are aimed at lowering the cost and reducing the time to procure and deliver construction and rehabilitation projects, while maintaining or improving project quality. Innovative delivery options such as D&B, along with concurrent engineering and fast track, techniques have received increased interest in the last three decades (Tianji *et al.* 2005). Many writers described the current state of the construction industry as a very competitive high–risk business, and delays are frequent and recurring in construction projects (Loudoun and Allan 2008, Chan *et al.* 2004). It encounters problems, such as lack of cooperation, absence of trust, delays, and ineffective communication (Toor and Ogunlana 2008). Chan *et al.* (2005) reported that the construction industry has been one of the slowest industries to innovate. It has delayed its commitment to R&D, failed to adopt partnering techniques, and

resisted working with strategic alliances (Beard *et al.* 2001). Eagan, (1998), argued that the construction industry needs new performance measures that are quantifiable and measurable. Citing Koskela (2000), Solis (2009) stated that a crises or pre-crises



Phase I Feasibility and Project Criteria	Phase II Preliminary Design & Project Definition	Phase III Final Design and Construction	Phase IV Commissioning and Start-up
Deliverables			
Schematic Design • Infrastructure • Facility • Process (DFF, P & ID, General Arrangement) Requirements **Production Requirements** **1. Cost Estimate-ROM** **2. Schedule – Preliminary** **3. Quality Requirements**	**Preliminary Design** • Infrastructure (Site, Utilities, Environmental) • Facilities (architecture, Structural. MEP) • Process Final PFD, P&ID, Equipment & General Arrangement) • Control/Instrumentation Definition **Cost, Schedule & Quality Criteria**	**Final Construction Documents** Procurement • Equipment P.O.s • Subcontracts **Construction**	**Commissioning** **Start-up** **Acceptance**

Figure 3.3. Design Build Phases of a Process Project

Source: DBIA, (2001)

exists in the construction industry which requires a new approach, a new construction theory, and a structural change from the current way that projects are procured and delivered. He proposed adding D&B to the construction model that originally was dominated by D.B.B option. Writers including (Loudoun 2010, Toor and Ogunlana 2008, Serpell *et al.* 1997) have identified problems with the industry which are summarized in **Table 3.1.**

Table 3.1 Some Reported Salient Problems with the Construction Industry.

#	**Salient Problems with the Construction Industry**.
1	The separation of the design from the construction process.
2	Inefficient project management structure and technique.
3	lack of integration/fragmentation.
4	Industry clients are not satisfied (cost, time and quality).
5	The supply team is not satisfied (poor work conditions, safety record, frequent changing location of work, low salaries).
6	Risky business, Limited Trust.
7	Inefficient communication. Poor work conditions.
8	lack of sufficient R&D.
9	Poor safety conditions.
10	Dominance of adversarial relationships, Litigations.
11	Adoption of low price bidding system.
12	Increased project complexity.
13	Limited innovation and lacks technology (lack of technology in design and construction, reliance on site based activities and unskilled labour.
14	Low profitability (short cuts, bankruptcy, and no investment in R/D) clients focus on cost rather than value, inefficiency of industry and too much waste.
15	Lack of cooperation, the industry is competitive only on price not quality, unpredictable, few barriers, few loyal long term strategic stakeholders, claims, disputes, litigations.

Source: (Loudoun 2010, Toor and Ogunlana 2008, Serpell *et al.* 1997)

A recent study by (Loudoun 2010) about the frequency of occupational injuries by young male workers in construction in Australia showed that this industry is recognized as a high risk industry with an injury rate of 91 injuries per 1000 people for young males. With the exception of items 8 and 13 from table 3.1 these problems were reported by Saudi scholars, practitioners and researchers as will be discussed in the following sections and in the following chapters.

There are many advocators, as well as, critics for this method of project procurement strategy. Proponents of this method [Tianji *et al.* 2005, Gidado and Arshi 2004, Koskela 2003, Beard *et al.* 2001, Molenaar *et al.* 1999, Cox and Thompson 1998, Turner 1997, DBIA 1995,] argued that successful application of this delivery option are found in many other industries such as manufacturing, aviation, digital and auto industries. These industries have applied the concepts of D&B principles successfully. Reported success in those industries has brought continued international pressure on construction industry to find faster procurement, increased productivity and higher quality performance. Gidado and Arshi (2004), add that design and construction go hand in hand in most industries. Clients, according to (Beard *et al.* 2001) will continue to drive the need for faster construction knowing the cost of waiting for projects to complete. A study by (Wang *et al.* 2009) in China regarding the pre-evaluation of engineering design project bidding reported the following:

> *" With thorough understanding of the scope of work, schedule definition, budget definition, project complexity, design builder qualification, there are projects characteristics that yield a greater potential for success when using D&B project delivery option" (*Wang *et al.* 2009, 586).

Anumba and Evbuomwan (1997) examined the process of concurrent engineering in D&B in response to the significant growth in the use of private and public D&B contracting in the UK. They proposed a process model that addressed shortcomings and identified two objectives. The first objective was to facilitate the concurrent project development in the D&B process through the integration of all project participants into a multi-functional matrix team capable of resolving potential "downstream" problems early in the project life-cycle.

The second objective was the provision of a formal mechanism for the improved abstraction of client requirements based on Design Function Deployment (DFD), a concurrent engineering design system. Chan *et al.* (2001) studied the different ingredients in successful building projects that used the traditional D-B-B and D&B procurement. They identified a gap between the two sets of the success factors. A common factor of paramount importance was the existence of partnering and long term work relations that significantly contribute to the success of D&B project delivery.

Critics of D&B option, on the other hand, use the same judging criteria. They argue that the client ends is up with less than optimum design with D&B. It compromises quality and offers mediocre design. Everything is designed to the worst case scenario, (Akintoye 1994, Tighe 1991). Other researchers criticize D&B contracting for its complexity. It extends throughout the process from finding the appropriate D&B firms, to preparing the performance specifications, to obtaining the necessary surety and proper bonding, (Tenah 2001, Friedlander 1998).The following sections examine the views of the proponents and the opposing of the D&B. contracting.

3.7 Some Views in Support of the D&B Delivery Option.

Literature review identified that both the proponents and opponents of D&B delivery option use the same judging criteria for evaluating the appropriateness, efficiency and validity of this delivery option. These points can be summarized as follow:

1. Impact on project cost, certainty of cost from the outset.
2. Time saving and time to delivery.
3. Impact on quality, innovation.
4. Suitability for specific projects.
5. Impact on work environment, communication and efficiency.
6. Risk management.
7. Impact on disputes. Change orders, litigations.
8. Subjectivity and Favouritism.
9. Influence on strategic alliances and small businesses.
10. Suitability of the contractual arrangements.

The following sections discuss each criterion and the views of both proponents and critics of D&B project delivery option.

3.7.1 Impact on Project Cost, Certainty of Cost from the Outset

The (AIA 2001) reported that for many clients, D&B contracting is a viable alternative. D&B combines the design and construction into a single procurement effort instead of separate procurement efforts for design and construction phases. This eliminates the administrative burdens and cost, shortens the total project time, encourages innovation by having the designer and contractor working hand in hand and resolving conflicts almost instantly. Design and construction activities progress concurrently rather than consecutively, which minimizes total project time.

> *"In the integrated design-build firm, there is no finger-pointing, all are responsible for design quality, construction quality, project profitability, schedule performance, safety, risks, a satisfactorily completed project, and a satisfied client." (*AIA 2001, 16)

Similar studies by (Ling *et al.* 2000, Konchar and Sanvido 1998) showed that construction cost of D&B projects is lower than D.B.B projects. Bennett *et al.* (1996) also reported that in the UK about 75% of D&B projects were completed within 5% of the established budget. In the USA, Consistent with these studies (Song *et al.* 2009 Molenaar and Songer 1998) reported that D&B projects have a higher chance of being delivered within budget. According to (Beard e*t al.* 2001, Adams 1999, Ndekugri and Turner 1994), some clients regarded this alternative delivery system as providing value for money. Masterman (2002), Pickavance (1998) reported that D&B offers contractors a new elevated role in leading this process. They show their expertise, and bring their knowledge and construction economics into the project. A questionnaire survey to 150 construction firms in the UK conducted by (Gidado and Arshi 2004), showed that 94% of the respondents claimed that using D&B contracting have resulted in 20% saving in time compared with other project delivery systems. In terms of cost, 75% of these respondents reported that up to 20% saving could be achieved using D&B contracting. A firm price and cost certainty from the outset is offered by the D&B delivery option (Tianji *et al.* 2005). As advocated by (Cox and Thompson 1998) the client is notified with the guaranteed construction cost from the outset. The D&B entity works concurrently on the design and on estimating the construction cost. The design and construction team as argued by (Tianji *et al.* 2005, Gidado and Arshi 2004) evaluates options, materials and construction methods efficiently. Better and cheaper alternatives and methods for design, construction and operation are sought that are consistent with performance specifications, contract budget and schedule. A study by (Ling, 2004) regarding how project managers can control the performance of D&B projects in Singapore showed that properly managed public sector D&B projects have significantly lower unit costs.

3.7.2 Time Saving and Time to Project Delivery

According to (Beard *et al.* 2001, Bennett *et al.*1996) D&B delivery system is ideal for the application of fast-track construction to reduce the overall project delivery time. Construction activities start earlier before construction documents are fully

completed AIA (1995). The overlapping of design and construction realizes the total shortening of schedule and cost as shown in **Figure 3.4**. Moreover, the contractor is involved in the design process at an earlier stage and encouraged to propose more

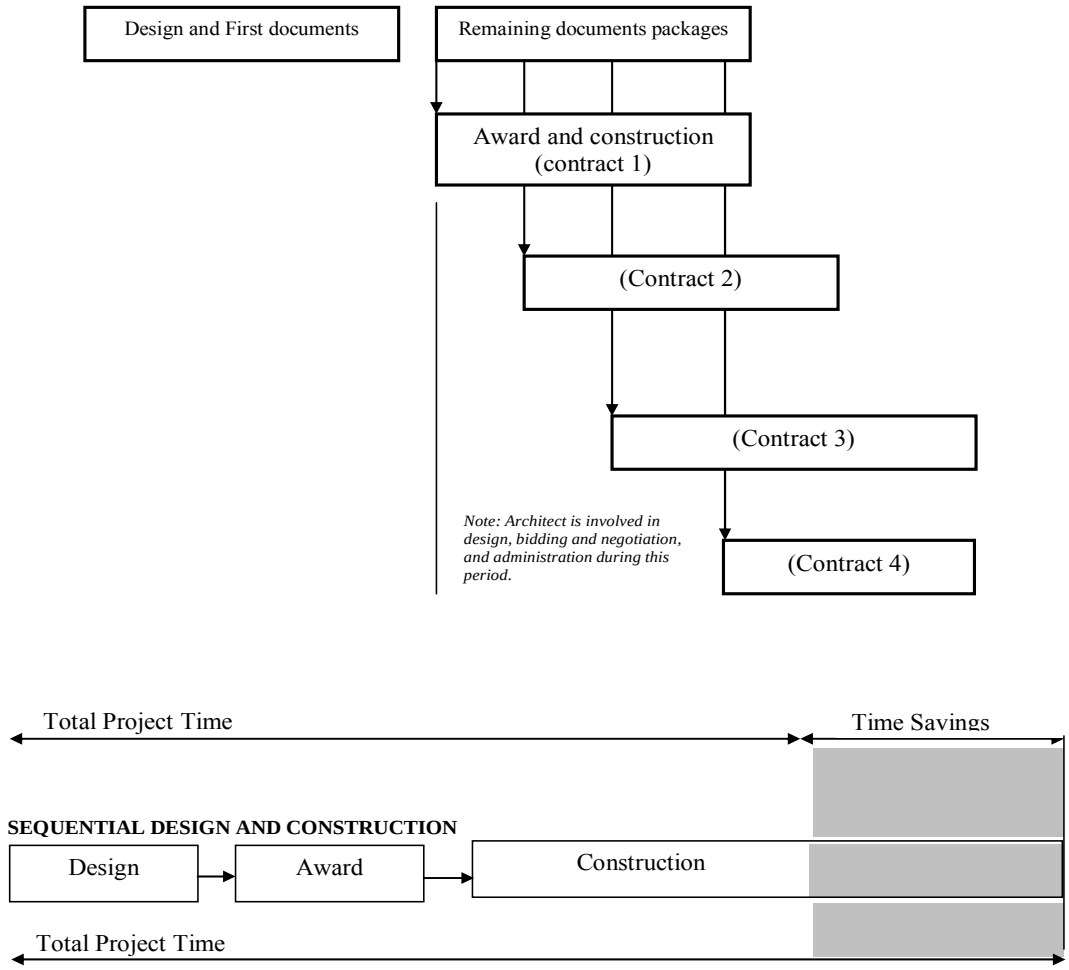


Figure 3.4. Design and Build Fast Track in Comparison with D.B.B
Source: AIA, (1995)

cost effective ways to realize the established performance objectives Edwin *et al.* (2005). Constructability and buildability are paramount concerns from the outset according to the AIA (1995). Song *et al.* (2009) reported that benefits from early contractor involvement in the design to the owner include but are not limited to improved schedule, cost, safety and quality performance. Beard *et al.* (2001) stated that construction can start faster, meet the quality standards and within cost constraints.

> *"The D&B process was selected by those clients because it offers the flexibility to respond to their urgent physical, financial, legal and political*

> *needs and restraints to a greater degree than can the traditional D.B.B"*.(Beard *et al.* 2001, 183).

Hashem (2005) studied the impact of proper planning and realistic scheduling methods on the success of D&B projects. He found that proactive and scientific planning based on reliable design and construction information can lead to faster completion on D&B projects. In neighboring Kuwait, Al Reshaid and Kartam (2005), discovered that the private sector is using D&B with great success and meeting schedule. Their survey findings also showed that:

> *"D&B will soon be the dominant method for project delivery with growing acceptance by the public and private sectors"* (Al Reshaid and Kartam, 2005, .319).

Citing an ENR survey, Sell (2003), reported that in the USA the private sector use of D&B contracting has been increasing in frequency during the past thirty years. D&B is used in a wide array of commercial and institutional applications. The primary reason for choosing D&B contracting was time and cost savings. Sell cited a recent survey by AIA (2001), and reported that 36% of AIA member firms were engaged with D&B compared with only 10% in 1979. The survey analysts forecast that D&B contracting will exceed 50% of the construction market between 2005 and 2010. According to (Konchar and Sanvido 1998) D&B projects in USA are found to be12% faster than the traditional projects without schedule overrun. Total delivery speed is 30% faster. In the UK and according to (Atkintoye and Fitzgerald 1995) contractors agreed that the use of D&B reduced overall project time.

3.7.3 Impact on Quality and Innovation

The common criticism is that D&B contracting leads to inferior quality in design and construction because the D&B team focuses on simplicity and speed. Conversely, proponents of D&B argued that this option is ideal, for design innovation, meeting quality targets and responding to the client's expressed and implied requirements, (Tianji *et al.* 2005, Chan *et al.* 2001). Konchar and Sanvido (1998) reported that, in the USA, D&B produced equal, and in some cases better, quality performance than D.B.B. Sell (2003), disagrees with the argument that D&B presents design professional with absolutely critical ethical questions which may impact the quality of the design. This is since the designer is working for the contractor. Sell's argued that ethics morals relate to individual decisions, not to the process of project delivery

since the market -place rewards honest, and ethical business practice and eliminates unethical behaviour.

In Singapore, (Ling and Leong 2002), conducted a study to empirically compare the performance of projects which used the traditional D.B.B and the D&B system. It is based on 14 performance measures and uses quantitative project data. The results of the study indicated that D&B performed well in terms of functional, architectural and technical quality. Chan *et al.* (2005), Beard *et al.* (2001) argue that the D&B entity will remain responsible for interpreting the client's requirements, focus on the project performance rather than conformance with prescriptive specifications that can be outdated, prepare design drawings that are complete, accurate, and according to established industry standards. Tianji *et al.* (2005) added that D&B option achieves better quality since D&B contracting has an inherent quality assurance verification plan. It encourages the integrated team to find the balance of design and construction. They avoid over pricing as they become aware of the true construction costs.

Hamel and Prahalad (1994) pointed out that 80% of construction industry managers believed that quality of products would be a fundamental source of competitive advantage in the next millennia. A study by (Dahl *et al.* 2005), regarding the effectiveness of Design-Build-Operate-Maintain (DBOM) delivery as a tool for sustainability showed that D&B contracting is considered by many clients as means to achieve better sustainable buildings. This can be achieved through effective integration between design and construction and involvement of the client in addressing, from the outset, the consideration for reduced energy consumption, lowering operation and maintenance costs.

3.7.4 Suitability for Specific Projects

Although size, complexity, risk and nature of the projects warrant the choice of D&B contracting, (Tulacz 2006) argued that the technology required may dictate the suitability of specific project delivery options. D&B contracting is ideal for procuring complex projects that involve specific technologies and high level of specialization such as power plants, process factories, and refurbishment of large historical buildings and factory projects. A survey by (Tulacz 2006) showed that D&B contracting is spreading internationally. The non-residential sectors revealed that the D&B is the project delivery system of choice on more that 50% of their construction projects in the European Community and on more than 70% of the non-

residential projects in Japan. D&B contracting as advocated by (Tianji *et al.* 2005, Chan *et al.* 2005, Turner 1997) provided an expeditious approach to complex process projects and proprietary projects. It integrates all technical, management, equipment, operations, maintenance, construction and regulatory skills. In USA, (Molenaar *et al.* 1999), studied public-sector D&B evolution and performance by examining and analyzing 104 completed public sector D&B projects. They reported that success was dependent on the client's experience, level of design completion, designer/builder selection, contract type, method of award, and design build process variations.

3.7.5 Impact on Work Environment, Communication and Efficiency

Several researchers studied the D&B process work environment and described it as a dynamic one. Fostering high team morale promotes efficient communication (Koskela 2003). Having change control mechanisms in place ensures the success of the process (Kerzner 2003, Chan *et al.* 2001, Alacron 1997). Beard *et al*. (2001) added that the right team work attitude, experience and commitment of senior management are all essential elements for positive results. This innovative contracting strategy represents a collaborative effort. The various resources involved provide the incentives for a high level of technical performance to consistency meet contractual budget and schedule terms (Jaweed, 2004). The team spirit encourages economical solutions (Gidado and Arshi 2004). Beard *et al.* (2001) advocate that D&B contracting unites the various teams and organizations together under a shared vision, mission and purpose. This in turn encourages conflict resolution, and brings a sense of urgency which translates into higher productivity.

3.7.6 Risk Management

Under D&B, contract risk management is defined from at the beginning of the project. Risks that could significantly impact the project are identified. They are assigned to the party most suitable to manage the impact (Tianji *et al.* 2005, Beard *et al*. 2001, DBIA 2001). Song *et al.* (2009) and Adams (1999) advocated that D&B contracting responsibilities and risks are shared by all team members over the course of the project. While the D&B entity takes full charge of the design and construction, the client is responsible to defining the scope precisely in terms of performance specifications and making rapid decisions. Risk of multiple design change orders is reduced since the D&B entity is fully responsible for the complete design services.

The client is subject to change orders when he/she changes the original scope or introduces new requirements that were not scoped in the design criteria package (Beard *et al*. 2001). Other D&B, subcontractors and suppliers with long term strategic relationships or partnering agreements with each other have the opportunity to share risks and rewards, (Black *et al.* 2000, Bennett and Jayes 1995). According to (Songer and Molenaar 1996) D&B has the potential to produce a more cost effective project with less time compared to a process that contractually insulates the project participants while leaving the client with most of the project risk.

3.7.7 Impact on Disputes, Change Orders and litigations

The single point of responsibility for the design and construction in the hands of the D&B entity shifts to them all responsibilities to comply with cost, schedule, aesthetics, planning and quality control (Tianji *et al.* 2005). Sells (2003) argues that with the traditional D.B.B path the owner's best interests are not protected. The architects and contractors strive to protect themselves from liability and change orders. However, the D&B entity is responsible to interpret all of the client's requirements that are stated in the scope of work and the performance specifications, without submitting any change orders for errors or missing information (Beard *et al.* 2001, Bennett *et al.* 1996). This work relationship promotes team work. It achieves a shared vision for meeting the projects goals. It also creates the desire to avoid claims, change orders, errors in design. This translates, according to (Song *et al.* 2009), to less adversarial relationships, conflicts, avoids litigation during and after project completion and encourages establishing long term business relationships. Pro-active thinking and problem solving takes priority over the confrontational relationships commonly found with D.B.B, (Sell, 2003).

3.7.8 Subjectivity and Favouritism

While low bidding continues to be a significant factor in contract award, especially in the sequential D.B.B delivery system, best-value approaches using multiple criteria (including cost) are gaining momentum, (DBIA 2006, Gidado and Arshi 2004, Beard *et al.* 2001). However, some clients who use the D&B option prefer and favour large contracting firms. Large firms are thought to have substantial experience, knowledge, expertise and the resources to procure projects using the D&B option. This biased approach is criticized by authors including (Tenah, 2001),

for preventing many small size contracting and design firms from bidding for major D&B projects.

3.7.9 Influence on Strategic Alliances and Small Businesses

D&B as argued by (Jaweed 2004, Bennett and Jayes 1995,) fosters partnering relationships conducive to strategic alliances and partnering relationships. Clients, designers and contractors are looking for long term business relationships. These long term arrangements are founded on trust. They keep the flow of work and realize mutual benefits. D&B contracting strategy promotes win-win relationships where the supply chain emphasis is on cost rather than price, continuous improvements rather than short term defects, prevention rather than quality checks, (Black *et al.* 2000). The heart of this partnering concept involves continuous improvement of the kind that Sir (Egan, 1998) alluded to in his report. Egan has set continuous improvement targets (10% per year on cost and 20% on defects).

3.7.10 Suitability of the Contractual Arrangements

A great concern is that the industry is well versed with the traditional D.B.B delivery option and its standard contracts and trade organizations that cover its application, (Koskela 2003, AIA 2001, Tenah 2001, Friedlander 1998). The construction industry and surety companies according to (Knight *et al.* 2002, Friedlander 1998) have not developed sufficient insurance and bond policies, laws and regulations, nor legal systems that govern the proper application of D&B contracts. Also subsequent bespoke arrangements are inadequately used regardless whether the direct negotiated contract or competitive bid arrangements. The contract arrangements should be established from the outset based on a precise scope of service and a certain degree of completeness of design drawings and performance specifications, (Beard *et al.* 2001, Chan *et al.* 2001). Other reported concerns were the lack of clear insurance policies covering the new role of the designer. These reflect changes in the designer's role from client's advisor to contractor's team mate (Friedlander, 1998). The insurance policies must treat design firms as partners with the contractors with liabilities not only for design errors and negligence but also for construction, (Knight *et al*. 2002).

To summarize, proponents of D&B argued that this project delivery method is more efficient, and cost effective for the following distinguishing reasons:

- The single point of responsibility with the design, cost, schedule, aesthetics, planning and quality and construction rests in the hands of one entity.
- Project cost is less. Clients save on design and construction since the two procurements efforts are combined in one phase.
- Time saving is realized since the design work progresses according to construction schedules and overlaps with it. The design boundaries disappear as illustrated in **Figure 3.5.** Since the contractor is involved in the design

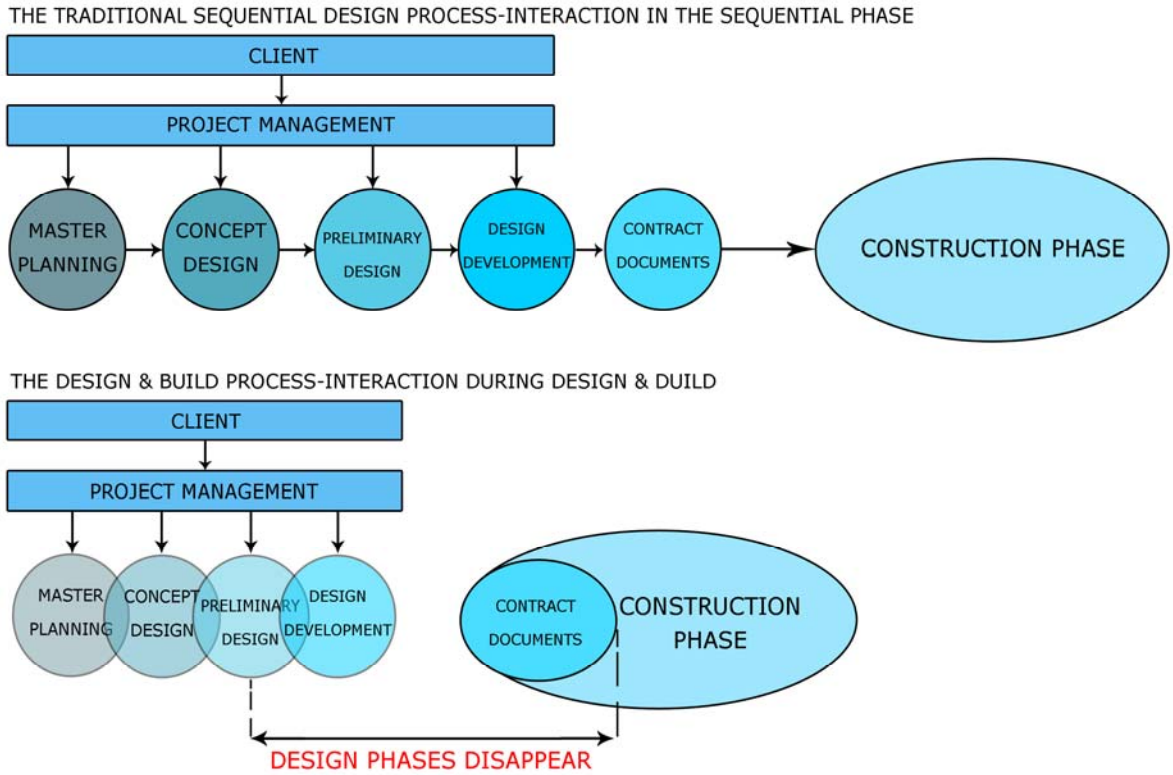


Figure 3.5. The D&B Option Overlapping of Design and Construction

process at an earlier stage. He proposes more cost effective ways to realize the established performance objectives.

- Innovation and better quality in design and construction is achieved. The combined team is motivated to meet the project performance standards rather than conformance with prescriptive specifications that can be outdated.
- Certainty of price is offered by the D&B delivery option. In most cases, the client is informed with the guaranteed construction cost from the outset.
- Risk management is defined from the outset. The D&B entity takes full charge of the design and construction. The client would be subjected to

change orders in case he/she changes the original scope or introduces new requirements.

- Collaborative work environment promotes team work. This results in a less adversarial relationship, eliminates potential legal confrontations and litigations, and encourages establishing long term business relationships.
- Open management environment occurs where problems are exposed without fear and solved mutually. Pro-active thinking and team problem solving is championed.
- The team commitments. Since the overall project duration is reduced, there is greater likelihood that the D&B team members will be kept together throughout the project lifecycle.

The above points are argued by the opponents of the D&B project delivery option including some researchers in Saudi Arabia who challenged the time saving results offered by this option as demonstrated in the following sections.

3.8 Some Criticism of the D&B Project Delivery Option

Opposing views criticize certain aspects of the D&B project delivery concept. They argue that D&B contracting, in many cases, is proposed as the answer to the failure of the original planning and scheduling of projects, (Oztas and Okmen 2003, Tighe 1991, Cramer 1994). Others believe that all project delivery systems must focus on achieving the optimum time, cost and quality targets irrespective of the choice of delivery strategy [Ling and Poh 2008, AIA 2001, Molenaar *et al.* 1999, Deakin 1999]. Research undertaken by (Hampton 2001) indicated that management of D&B project is more problematic than D.B.B. Architects and engineers spend 20-30% of their time searching for and handling information related to coordination, scheduling and interpreting the client's brief.

3.8.1 Impact on Project Cost, Certainty of Cost from the Outset

According to Tighe (1991) the benefits of D&B and fast track techniques with their promise of speed and cost saving, are a myth. Tighe stated that with proper project planning and scheduling and control, fast tracking a project should be unnecessary. Improvements to the construction methods should be used whenever beneficial without embarking on accelerated methods.

> *"Everything will be designed to meet the worst scenario, the mechanical and electrical engineers will over-size their systems to ensure adequate capacity. The architect, fearing the unexpected risks will allow more space than required. The structural engineer will add a safety factor to ensure that the facility will structurally allow for an increase in load later on. The result is giving the owner less than optimal design and greater construction cost"* (Tighe, 1991, 50).

D&B is also seen by some industry stakeholders, (Tenah 2001) to have a negative impact on the overall cost and design quality of the project due to the high level of uncertainties inherent in the process. As a result, many D&B clients experience overspending and less than the optimum product. Evbuomwan (1997) claimed that there is evidence that certain consulting offices proposed this approach without conviction just to win a project. Studies of South African D&B projects by (Bowen *et al.* 1999) showed that D&B was lagging behind D.B.B in achieving cost objectives and cost certainty.

3.8.2 Time Saving and Time to Project Delivery

This is an area of substantial debate. According to (Gidado and Arshi 2004, Tenah 2001, Akintoye 1994), if D&B is not implemented efficiently, it may cause clients to spend more money and time. According to (Ormerod, 1996) D&B project delivery option is not faster than the D-B-B option. It can take months to develop the scope, select the team, prepare the performance specifications and client brief accurately. Molenaar *et al.* (1999), Anumba and Evbuomwan (1997), argued that performance specifications and incomplete design drawings may lead to misinterpretation, confusion, conflicts, and claims. More time and cost is spent than originally envisaged. Knight *et al*. (2002) believe that preparing the full requirements of the project brief that is comprehensive enough to assure compliance but also avoids restrictive details that inhibits creative solutions, can be time consuming and in some instances, off sets the potential time saving that is being sought. Project urgency and innovation were the primary motivations for using D&B contracting, according to DBIA (2005). In many cases cost considerations and low bid selection remained the main factors for awarding D&B contracts. Inexperienced clients do not have the capabilities to check the design or to make critical decisions on design or

construction issues. This causes delays to the entire project and may lead to a longer delivery time than anticipated (AIA 2001, Beard *et al.* 2001)**.**

3.8.3 Impact on Quality and Innovation

The D&B delivery approach is repeatedly criticized for failure to produce creative design solutions and not meeting the quality standards of the client. Because of the time pressure to design and build faster, there is a danger that simplicity of the design becomes more important. Poor coordination may occur if less time is allocated for proper detailing and specifying of the design requirements, [Gidado and Arshi 2004, Friedlander 1998, Akintoye 1994, Tighe 1991, Fazio *et al.* 1988]. A study of 351 design and construct firms was organized by the (AIA 2003), and conducted by Penn State University. It ranked various factors in D&B project delivery. The study found that D&B projects resulting from the forced marriage between architect and contractors ranked last in quality among all projects types**.** Holt *et al.* (1995) reported that D&B has been criticized for mediocre design and compromised quality. The design aesthetics are overlooked due to the shift of the D&B team's attention towards cost and schedule considerations. Clients receive a compromised building. It is unable to meet their stated and implied objectives because the cost is more than planned, it is delivered behind schedule, or it failed to meet the project performance criteria (Tenah 2001, Molenaar *et al.*1999).

Knight *et al.* (2002), Beard *et al.* (2001) attributed the fear of meeting quality targets to a change in the architect's role. The architect's role is confused since He/She no longer serves as the client's advisor to protect the quality of design. Now, the architect participates as the contractor's partner. Knight *et al.* (2002) claimed that under D&B many architects can not align with contractor's means of communication and choose to short circuit the normal design process. The architect either produces less than optimum designs or prepares designs to interpret the contractor's design brief. This process arguably allows clients little time to review design drawings (Konchar and Sanvido 1998). Moreover, (Tenah 2001, Pickavance 1997) added that quality of design suffers since the D&B entity always attempts to match quality to the established guaranteed maximum price. The associated fear of compromised quality has led to the use of extended performance warranties to ensure that the specified material and workmanship quality standards are achieved on the project.

3.8.4 Suitability for Specific Projects

Murdoch and Hughes (2002) suggested that D&B delivery approach is best suited for clients who are experienced with the option, have trained personnel in preparing RFP(s) or facility programs, are familiar with the D&B inherent procedures, and are skilled in managing and administering the various planning and procurement stages. DBIA (2001) described the process as a complex one. Kerzner (2003) is of the opinion that D&B project procurement strategy offers clients insufficient time to suggest modifications and changes during construction. Also, compliance with the established performance criteria can not be checked. Many mistakes can be made that may be irreversible. Hashem (2005) believes that this project procurement system is better suited for rushed projects, restoration and historical projects, and projects that have to be built in a limited time span with absolute deadlines. Tenah (2001) revealed that projects, requiring a long period of time, mandate that the D&B entity finds the experienced team that will stay on the project from the outset through the completion of construction. Chan *et al.* (2005) argued that the D&B contracting process is complex compared with D-B-B option. The construction industry is less familiar with this delivery approach. As a result, the unfamiliar is avoided. D&B project delivery, as argued by (Friedlander 1998) requires careful assessment, of the project components. The risk element of dealing with too many unknowns renders any D&B project as high risk and to be avoided.

3.8.5 Impact on Work Environment, Communication and Efficiency

Many writers argued that D&B contracting requires a new organizational structure, work culture, and increased coordination efforts (Knight *et al.* 2002, Murdoch and Hughes 2002). These factors are critical to D&B projects to ensure prompt and effective communication and coordination amongst all project stakeholders. Beard *et al.* (2001) added that other relevant problems may arise with the new role of the architect. The architect-engineer is not communicating directly with the client. This may present a danger. The client's needs and wants may be misinterpreted and mis-communicated. Rework and project inefficiencies occur. The clients' value system and implied requirements may not be recognized. Chan *et al.* (2001) reported that since D&B focuses on construction activities, often little attention is given to the design team. Consequently, the designers may feel that their traditional leadership is

threatened and undermined. Their voice is unheard. This feeling may lead to a confrontational relationship within the D&B team. They added that it could also force the D&B team to consider quick design fixes resulting in inferior work.

3.8.6 Risk Management

Risk identification and risk allocation were heavily debated by proponents and critics of D&B project delivery system. According to (Ling and Poh 2008), compared to the D.B.B it is more difficult to evaluate D&B tenders because of the need to evaluate both price and designs based on limited design and price information. This situation exposes the D&B clients to more contractual risks. Other views from (Oztas and Okmen 2003, Cox and Thompson 1998), indicated that the D&B approach has inherent litigation risks because incomplete documents are used. Due to the many unknowns and lack of design certainty, (Oztas and Okmen 2003) warned that conflicts increase under D&B contracting and its ally fast track project delivery.

> *"D&B turns to be a risky contract system for both the owner and contractor unless the risks are identified in advance and managed throughout the project. Project risks increase their intensity under D&B system in developing countries like Turkey"* (Oztas and Okmen 2003, 231)

Citing Okmen (2002), they added that the level of risk allocated to the parties in D&B process greatly varies with respect to the payment method executed within the project. A greater portion of the risk is transferred to the contractor when the fixed-price payment method is used. The owner is in a more relaxed position in this situation as illustrated in **Figure 3.6.** The (AIA, 2003) outlined five areas of perceived risks that some industry participants fear:

1. Inherent risk of the process itself.
2. Diminished design control.
3. Organizational complexity.
4. Separating the design science and art discipline form the construction science.
5. Complex insurance and multiple permit requirements.

The element of inherent risk in the D&B and fast track delivery options was also considered by (Kerzner, 2003). Accelerating the schedule implies that additional risk is taken by the D&B entity. If risks materialize, the end date will slip or expensive rework will be needed. Rework in a D&B project will take longer to complete than originally planned. The risks and potential mis-management of integrated delivery

projects were also studied by Pickavance (1997). In his view, the growing emphasis on D&B procurement and a fast track strategy are a manifestation of the desire to reduce the project duration. However he reported:

> *"Accurate forecasting of time allowances and monitoring of progress is thus vital if progress is to be effectively maintained and time- loss minimized"* (Pickavance 1997, 29).

3.8.7 Impact on Disputes, Change Orders and litigations

Tenah (2001), Murdoch and Hughes (2002) argued that misinterpreting the facility program or brief by the D&B entity was a source of disputes between clients and D&B firms. Friedlander (1998) reported that D&B related litigation tend to take longer time due to the following reasons:

1. Much of the existing industry insurance bonds, policies, and laws have to a great extent developed around the traditional design bid build model.
2. The judicial systems in many countries still are not fully acquainted with the obligations and liabilities of D&B contracting. As a result, judges and lawyers appoint special committees to clarify responsibilities and obligations in D&B contract in order to resolve any conflict or legal case.

Anumba and Evbuomwan (1997) reported that the development of the conceptual design drawings into construction drawings may be a source of disputes between clients and D&B entity. This occurs when the client discovers that the construction documents do not reflect the design intent. An international consultant practicing D&B procurement in the Gulf region since 1990, Ronald O. Van Pelt, senior vice president of WAT&G consulting office argued that rushing into D&B and fast track as the way of procuring projects has proven to be a failure. Site activities can not start with minimal information and improper coordination. He stated:

> *"What I often see is that projects that are pushed so hard do not end up getting finished any faster. One can not finish a project more quickly unless you want to spend more money, or settle for less quality. You can send more ships across the ocean but they do not get there any faster. Why not be honest to the client and give realistic schedules"* (Van Pelt, 2005,12-13).

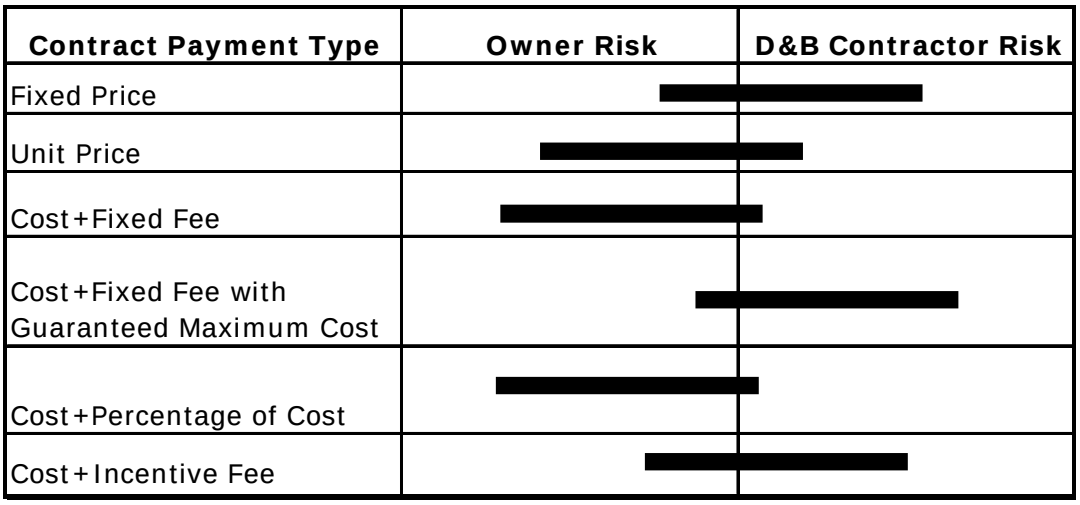


Figure 3.6. Risk Distribution between Parties in D&B Contract System
Source: Oztas & Okmen (2003)

3.8.8 Subjectivity and Favouritism

Research showed that some scholars and writers criticised D&B contracting because it favours award based on low cost in the final stages of contract selection process. Murdoch and Hughes (2002) believed that project urgency and innovation can be primary motivations for using D&B approach. However, a low bid seemed to be the decisive factor for awarding D&B contracts. Other qualitative factors such as track record, organization structure, team reputation, and (best-value) quality concerns only mattered in the initial stage when short lists are selected, (AIA 2001, Turner 1997). Knight *et al.* (2002) added that because of the high costs associated with preparing D&B proposals, fewer medium and small size firms, with limited resources, respond to D&B projects invitations.

3.8.9 Influence on Strategic Alliances and Small Businesses

Research did not reveal negative impacts resulting from strategic alliances collaborating in D&B contracting. However, there is evidence that many clients prefer to select large firms to procure D&B projects. Small businesses suffer as a result of this trend, (Beard *et al.* 2001). Limited interest from small firms in D&B contracting can be, according to (Knight *et al*. 2002), attributed to the following reasons:

- The perceived risk in committing to a price without having the full detailed design documents.
- The high cost of preparing design and financial proposals.
- Lack of sufficient rules and regulations that formalize the relationships between the D&B parties.
- Lack of internal organization structure with the mind set to reorient their thinking to manage projects along D&B contracting.

Similarly, and according to the (DBIA, 2001) due to the proprietary nature seen in the process industries, such as Food and Dairy, Pharmaceutical, Beverage, many clients tend to partner with selected D&B organizations. This is essential to maintaining a comfortable level of confidentiality regarding their products. It limits the spread of their "know-how" to others. Moreover, this arrangement is also advantageous to the design builders' organizations. They can develop long term relationships with their clients working with standard contract terms that are acceptable to both parties. Research showed debate over the negative impact of D&B on small businesses. Loulakis (1999), Beard *et al.* (2001), Tenah (2001) argued that because D&B requires significant resources and expertise which some small business lack resources to compete. Moreover, (Friedlander 1998), added that many clients prefer international D&B entities, to procure complex and large scale projects. International D&B entities are viewed to be more versed in this delivery approach. They also are knowledgeable with the legal and contractual arrangements that govern the D&B delivery system.

3.8.10 Suitability of the Contractual Arrangements

Specific contractual, organizational, and cultural knowledge requirements are necessary for procuring projects utilizing D&B contracting. Inexperienced D&B firms will find it difficult to enter the D&B market. Similar difficulty is encountered by firms without the proper insurance and liability coverage (Friedlander, 1998). Contractual arrangements and insurance requirements mandate that only experienced firms can procure projects along D&B contracting (Beard *et al.* 2001). DBIA (1995) recommended that firms interested in this delivery option must initially invest in training their employees. Then they can embark on this delivery approach. To encourage D&B contracting, (DBIA 1995), proposed the availability of several

variations of the D&B contracting. As demonstrated above, clients should choose a specific D&B contracting process variation based on several factors including:

1. Type, nature and level of complexity of the project and the extent of proprietary items involved in the design and client's know how.
2. Client's knowledge and experience with D&B contracting coupled with the willingness to be involved personally, or through their in-house team, in this process throughout the project.
3. Availability of funding.
4. Availability of insurance coverage.
5. Client's views on risk allocation, sharing and responsibilities.

Friedlander (1998) reminded that there are some legal and contractual issues with D&B contracts. Lawyers and insurers, according to Friedlander, warn design consultants to steer clear of the means, and methods of construction issues and to avoid any involvement in issues of job site safety. Based on his personal involvement in large number of D&B projects in the public and private sector, Friedlander identified a number of problem areas that require solutions which include:

- The relationships and loyalties among the parties.
- The design professional's standard of care.
- Performance warranties.
- Entertainment to change orders.
- Licensing problems.
- Conflicts with competitive bidding laws.

The (AIA, 2001) reported that certain insurance carriers and bond sureties may not be familiar with the limits of each professional entity with D&B contractual arrangements. This can lead to hesitation by industry firms to procure projects with a D&B contract. With D&B contracting, the boundaries, obligations and responsibilities of the parties overlap. The parties to the D&B contract may not be aware of the comprehensive coverage and bonding language that is separately or jointly required. The insurance and bonding issues present a roadblock for firms seeking entry to D&B field. Murdoch and Hughes (2002) added that the release of multiple, phased building permit approvals for specific sections of projects with appropriate planning and safety requirement approvals will remove many barriers to D&B contracting.

The above views suggest that there exists resistance to the full implementation of D&B in the construction industry. Unrealistic schedules lead to short cuts. Short cuts compromise quality and often result in repairs and repeated work. Overestimation of the required efforts results in complacency, waste, and low productivity. The conflict in the fast track process is clear due to the risk of rework, running over budget, and non-compliance to quality standards. In summary, the industry participants who criticise D&B for its high risk and uncertainty, complexity and poor quality in design and construction argue the following points:

- D&B project delivery strategy is one of the most controversial project delivery approaches. It changes the fundamental way the three main stakeholders (client, consultant and contractor) in the construction industry compete and cooperate with each other.
- D&B provides an opportunity for favouritism to enter into the contract award process by including non-price factors in the basis for selection.
- Buildings run the risk of being designed for ease of constructability rather than operability.
- D&B option lacks sufficient rules and regulations that formalize the relationships between the D&B parties. This opens the door for misinterpretation.
- Undermines the inherent checks and balances between design and construction teams found in the traditional D.B.B system, with the design team no longer independent of the construction contractor.
- There are inadequate checks and balances to ensure product quality and integrity.
- Strikes at the foundation of the traditional quality assurance and quality control roles through the combination of engineering design with construction and increases project costs due to the elimination of the low bid contractor selection criteria.
- Cost control may take lower priority than the program scope.
- There are some legal, liability and insurance bonds issues with D&B that are problematic to resolve.
- Design changes can be disastrous, as there is little time to stop the impacts that affect the other work packages.

- An integrated and experienced team with D&B is needed at an early stage of the D&B project. This could present a problem since it is difficult to maintain the same team throughout the entire project life cycle.

Based on the above review, careful planning and proper definition of the scope of work is required to manage D&B projects within cost, time and performance. Knowledge in design and construction technique is also needed. The success of D&B hinges on the experience and knowledge of the D&B team and the willingness of the client to embark on this delivery. However, the contentious issues with D&B are the greater risk, repeated changes, wrong decisions and rework, an unhealthy work environment and continuous pressure. In conclusion, it seems that the majority of the opinions pertaining to D&B are in support of new innovative concepts and techniques to improve the speed and quality of project delivery.

3.9 Design Build in other Industries

The separation of design and construction is not the standard process in other industries. The aviation, manufacturing, process, digital, heavy equipment, and automobile manufacturers, plan, design, and produce complex, expensive, safe products and in a very reasonable time frame (Eagan, 1998). In their study of refabricating architecture, (Kieran and Timberlake 2004) described the automotive industry as dynamic, competitive and efficient. It is regularly defining new ways of doing things, building new capabilities, setting new standards. It moved into the realms where quality and scope can increase out of all proportion to cost and time.

3.9.1 Design and Build in the Manufacturing Industry

The manufacturing industry is known for their thoroughness in market research, careful analysis of current buying behaviours, competitor analysis and industry structure analysis (Dyer 1996, Hamel and Prahalad 1996). Latham (1994) has turned attention to the institutions of the construction industry and to the culture they have developed, to improve the industry's efficiency and productivity. Other industries have successfully integrated design, construction, and product development into one single process using various techniques commonly referred to as:

1. Design and Build.
2. Concurrent Engineering (CE).
3. Design for Manufacturing.
4. Design for New Product Development.

5. Simultaneous Engineering. 6. Collaborative engineering.
7. Parallel Engineering, 8. Design for excellence.
9. Life Cycle Engineering. 10. Lean production theory.

The manufacturing industry was quick to understand the essential factor in product development (Burger 2000, Huovila *et al.* 1994). One of the methods that has been successfully applied in product development is Concurrent Engineering (CE). Concurrent Engineering, according to (Shouke *et al.* 2010, O'Driscoll 2002, Swink *et al*. 1996, Cleetus 1992), is a systematic approach to the integrated, concurrent design of products and related processes, including manufacturing and support. It embodies team values of co-operation, trust and causes the developer, from the outset, to consider all elements of the product life cycle from concept through disposal. Issues include quality, cost, schedule, and user requirements. The full participation of the engineering team is involved in the functional manufacturing of a product. The objective of this integrated approach as argued by (Anumba and Evbuomwan 1997) is to simultaneously consider all functional and performance aspects in the design and manufacturing process. Potential design and manufacturing problems are considered and their solutions are taken into consideration, [Kumar and Phrommathed 2006, Sapuan 2005, Holden 2000, Howell and Ballard 1997, Kao, *et al*. 1995, Carter and Sullivan (1994)].

Kusiak (1993), Ziemke and Spann (1993) argued that CE, as well as, its subsets Design for Manufacturing (DFM) and Design for Assembly (DFA) are not recent concepts in manufacturing and engineering. Rather, they have been parts of engineering design philosophy for many decades. Swink *et al.* (1996) studied the implementation of concurrent engineering in the new product development. Five companies that have customized concurrent engineering to meet their specific product and market needs were included in the research. These companies were:

- Boeing Commercial Aircraft division-777 project.
- Cummins Engine Company.
- Red Spot Paint and Varnish Company.
- Texas Instruments.
- Thomson Consumer Electronics.

They reported that through full implementation of concurrent engineering principles these five companies reduced development time and costs by moving quickly from

design to prototype to final production. These companies form small informal teams that are led by design engineers and managers. Intensive interaction occurs between product designers and manufacturing personnel, with cross-functional integration and communication. They conduct regular design reviews and share design data at the initial stages of the product development. All these work procedures were found to be common in these five companies. Carter and Baker (1992) emphasised that CE process brings unity to the design and production team through closer cooperation. They suggested the use of a company assessment questionnaire. Results were plotted on a graphic view as shown on **Figure 3.7.** It characterises the present development environment of the company.

The communication infrastructure gives an effective communication and data feed back to meet customers expectations.

O'Driscoll (2002), Korngold and Luscher (2000) explained that Design for Manufacture (DFM) as the practice of designing products with manufacturing in mind. The goal is to reduce the costs required to manufacture a product while improving the ease of making that product. He stated that the concept of (DFM) dates back to 1788 when Le Blac, a Frenchman, devised the concept of interchangeable parts in the manufacture of muskets which previously were individually handmade.

O'Driscoll argued the traditional sequential approach to product development illustrated in **Figure 3.8** does not recognize the impact of design on downstream functions. O'Driscoll continues, the integrated (DFM) approach, illustrated in **Figure 3.9** avoids these redesign and cost pitfalls through the integration of the activities depicted in the flow charts. Another stream of scholars studied the cost impact in using various (DFM) and simultaneous engineering techniques in the manufacturing and digital industries. Although design costs consume about 10% of the budget, in contrast 80% of manufacturing costs are determined by the design of the product. Chakravarty (2001) studied the final cost (build) that resulted from minimizing project time and reported that approximately around 20 -25 % of cost can be saved by integrating and overlapping the design and manufacturing cycle. This occurs even if some uncertainty is present when the downstream (build) activity commences before the upstream (design) is well advanced.

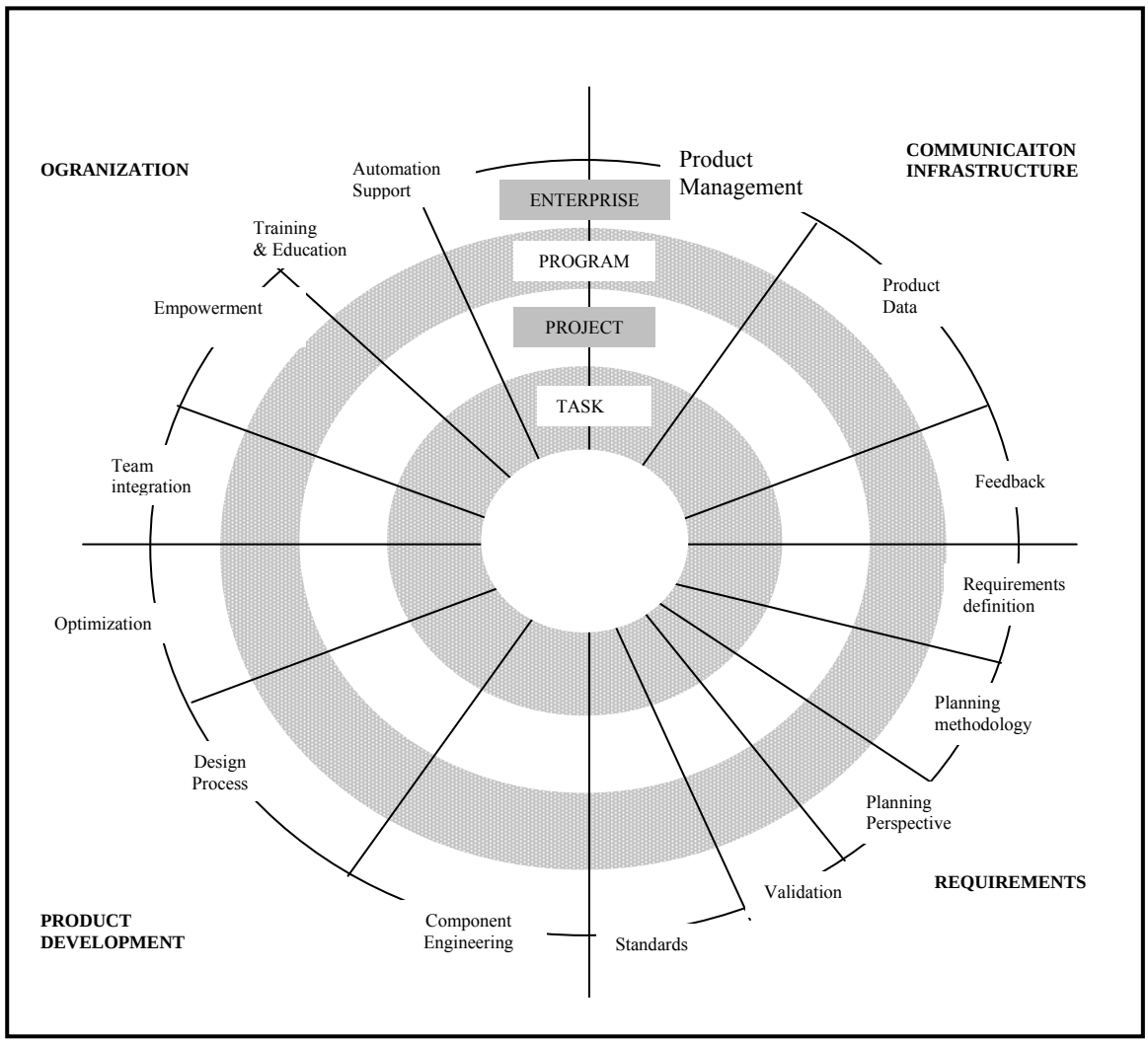


Figure 3.7. Concurrent Engineering Map.
Source: Carter and Baker (1992).

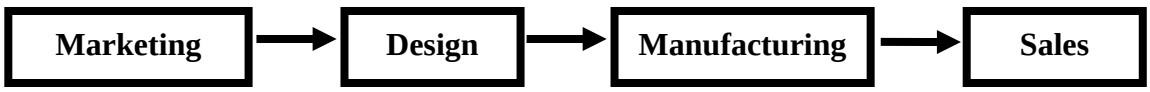


Figure 3.8. Sequential Design Approach
Source: O'Driscoll (2002).

It is understood that certain amount of reconciliation of work precedes design. Another form of D&B management that is successfully implemented in the manufacturing and the automotive industry is the Lean Production Theory, (Koskela 2003, Krishnan *et al.* 1997, Freiboth *et al.*, 1996, Shingo 1992). This theory was invented in Japan with the primary objective to promote team work, continuous

improvement, elimination of waste in time, and equipment, reduction in cost, and the ability to bring new technology to the marketplace as rapidly as possible. At the core of this production philosophy is the realization that there are two aspects in all production systems.

- Conversion
- Flow

Only conversion activities can add value to the material, or a piece of information being transformed into a product. Focus is placed on reducing and eliminating the non value adding activities, or flow comprising waiting time, inspection, travel, and moving. Conversion activities will thereby be made more efficient Cooney (2002). Everything is focused on productivity, improvement, and cost reduction by simulating the employees. Every team member manages his or her own problems. Review of research as argued by (Koskela 1997) showed that Lean paradigm employs simultaneous engineering. Design and manufacturing activities run in parallel, waste in the work process is eliminated, information and communication are direct, suppliers are heavily involved in developing the products and the common goal is satisfying the client. Supplies and parts are delivered to the assembly line on Just In Time basis (JIT) without any need for large storage and inventory space (Koskela 1997, Freiboth *et al.* 1996, Ohno and Mito 1988).

Lean Production Theory according to them proved to improve delivery time and reduces waste by**:**

- Rapidly reducing uncertainty
- Reduce flow variations
- Promotes concurrent engineering
- Match labour to available work
- Bring stability to the process by more efficient negotiations between ends and means at every level.

Simons and Zokaei (2005), Moore and Gibbons (1997), argued that Lean paradigm is applied in major manufacturing companies in USA and Europe. It has had a profound impact on the automotive and electronics industries.

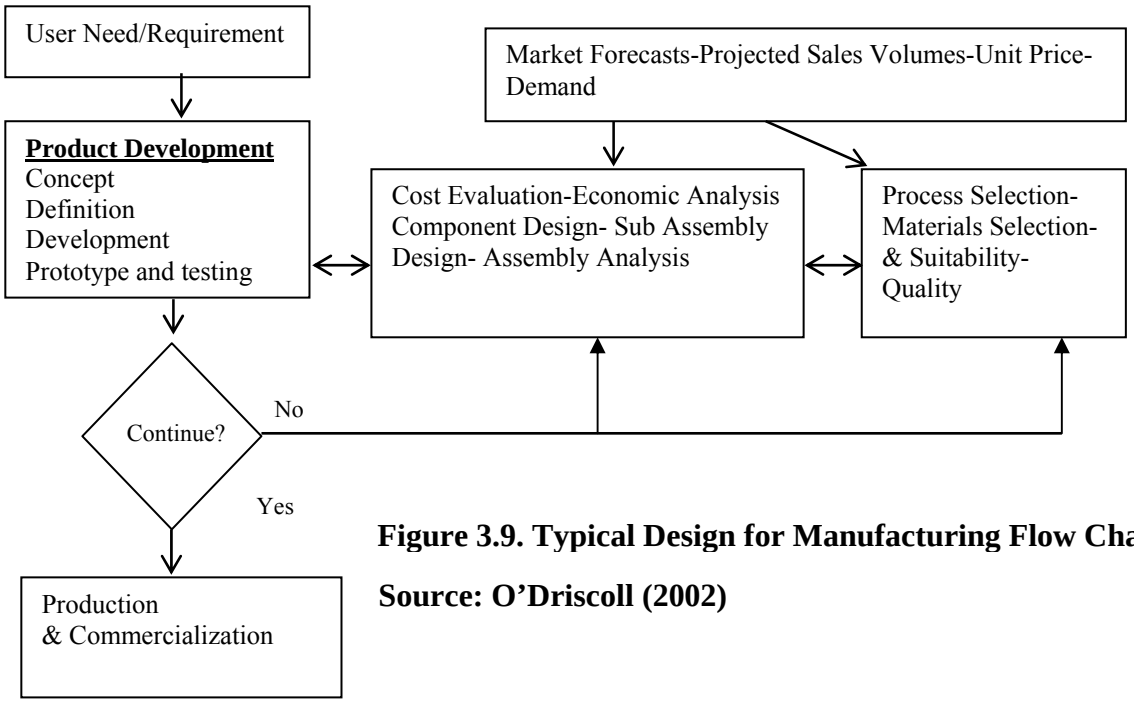


Figure 3.9. Typical Design for Manufacturing Flow Chart

Source: O'Driscoll (2002)

Howell and Ballard (1997) pointed out that construction is a complex process full of uncertainties and variations. This makes it different from manufacturing. Variations and changes occur at every stage of the construction process. These uncertainties and variations include:

- Design drawings and specifications change.
- Clients introduce changes too late.
- Suppliers almost always delay materials and equipment.
- Accidents, poor weather and unforeseen circumstances occur unexpectedly.
- Absence, strikes and new laws.

Other researchers (Serpell *et al*. 1997) added that construction has its peculiarities that make it different from other industries since it is:

- One of a kind nature of project.
- Site production, (not under a factory control).
- Temporary multi-organization without long term partnering and strategic alliances.
- A class of its own different from manufacturing which is stationary under one roof.

Koskela (2003) questioned the one-of-a kind nature of construction projects. He argued that the same peculiarity is shared by many if not most product development projects in manufacturing. One–of-a-kind is reduced through standardization, modular coordination and widened role of suppliers and contractors. The difficulties of site production are alleviated through increased prefabrication, and through specialized or multi-functional teams. The number of temporary linkages between organizations can be reduced through encouragement of long term strategic alliances such as partnering. Koskela argues that:

> *"Construction places its hopes on external ideas as drivers for change such as industrialization or Information Technology and communication" (*Koskela 2003, 90).

Koskela argued that construction industry needs big foundational ideas of change. This change covers the structure of the industry, (how projects are procured), its behaviour, (cultural attitude) communication, (information technology management), and physical, (use and type of machinery/equipment).

Eaton (1994) developed a model that depicts the Lean productivity improvements of a small firm over time as shown in **Figure 3.10.** He argued that by concentrating on the monadal conversion activity attention is directed towards the reduction of time and/or efforts required for each activity. The productivity improvement is represented by the monadal shrinking in size as time passes from (a) through (b) and ending at (c). The intra-monadal flows are examined so that flows within a monad are modified so they converge on focal point at the axis of the monad. This represents productivity improvement. Several practitioners and researchers, government officials and industry writers are of the opinion that the current construction approach has significant mount of waste non-value adding activities.

Conventional measures do not address this waste. It is invisible in total terms and is considered to be un-actionable, (Huovila *et al*. 1994).

Mohamed (1995) noted that construction output has been characterized by fluctuation in productivity. He advocates that construction industry can be brought to the same level as manufacturing industry to improve its performance.

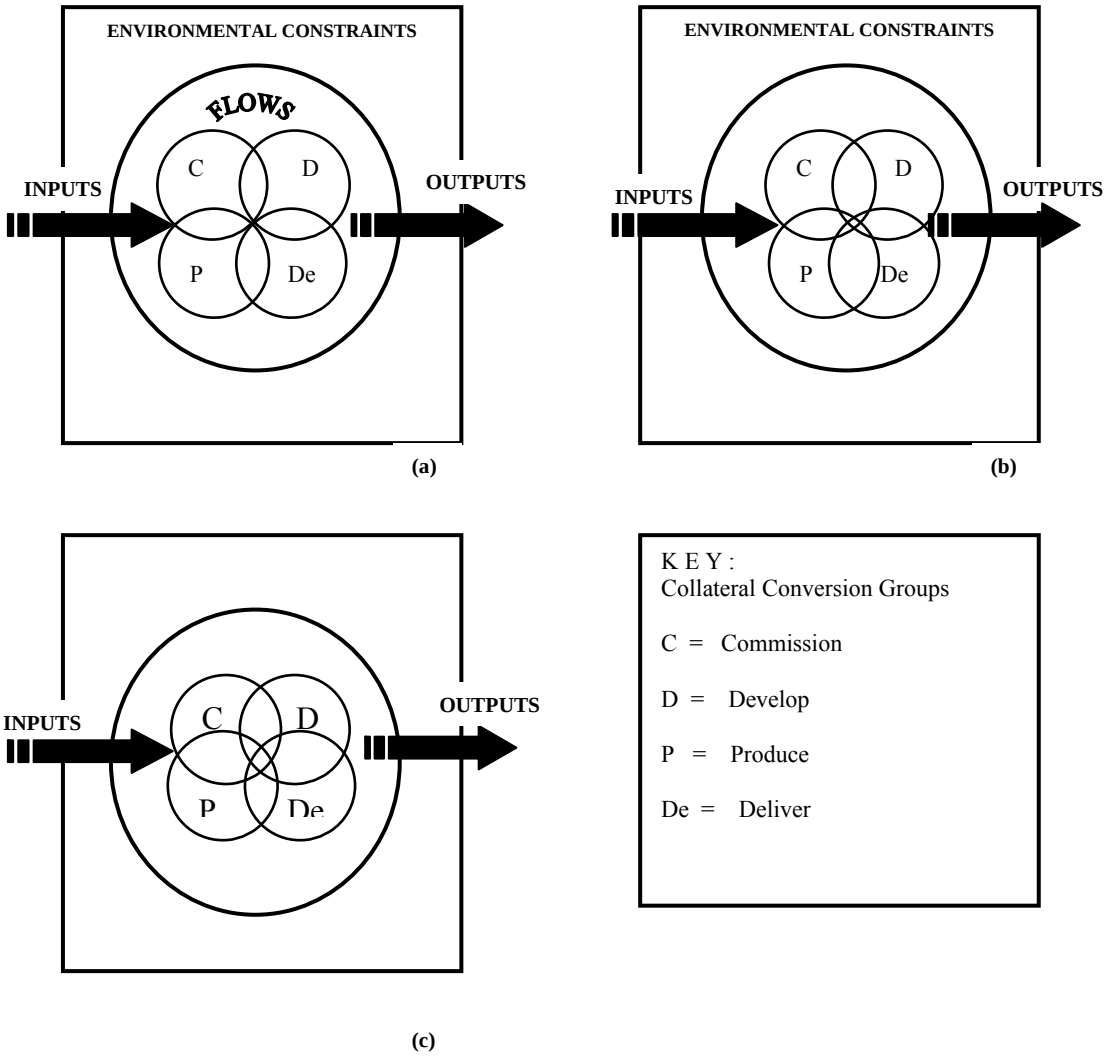


Figure 3.10. Lean Production Congruence Improvements Model.

Source: Eaton (1994).

Howell and Ballard (1997) studied the level of uncertainty between manufacturing and construction that distinguishes construction from manufacturing as summarized in **Table 3.2**. They argued that construction must come to grips with the entire design and construction process. Increasingly complex projects are being pressed forward under greater uncertainty. Koskela and Leikas (1997) studied the current planning procedures in executing projects. They reported that it is not enough to change construction to look like (traditional) manufacturing. Rather the total design–fabrication-erection process should be designed and improved so that significant benefits emerge. The traditional planning techniques are no longer valid because:

Table 3.2: Different Level of Uncertainty in the Context of Manufacturing and Construction Production.

	Start of manufacturing production	Start of construction in the field
What	Highly defined	Evolving as means refines ends.
How	Highly defined. Operations plan is in great detail based on many trails. Primary sequence of major task in process determine required skills.	Partly defined but details un-examined. Extensive planning remains as situation evolves. Primary sequence only partly determined by hard logic but may change. Interdependencies due to conflicting measurements, shared resources, and intermediate products only partly understood. General craft skills to be applied in a variety of positions.
Assemble objectives	Produce one of a finite set of objects where the details of what and how are known at the beginning of assembly.	Make the only one. The details of what and how are not completely known at the beginning of assembly.
Improvement strategy	Rapid learning during the first units preparing for production runs.	Rapid learning during both planning and early sub-assembly cycles.

Source: Howell and Ballard (1994)

1. They hide the relationship between design (engineering), procurement material supplies, prefabrication of components, or off site assembly and assembly on site they focus on assembly.
2. They can not cope with the complexity of projects (difficult to match actual progress with initial plan).

The emphasis on control affects human factors and the morale of workers. They argued that a better planning system is needed to recognize and encourage the efficiency (Lean), innovation and continuous improvement.

3.9.2 Design and Build in the Digital Industry

Similar to the manufacturing industry research revealed that the digital industry which has been around since the invention of the transistor, (Hamel and Prahalad 1996)**,** applies the integrated solution for the design and manufacturing of new

products**.** The cost and complexity of R&D efforts today, coupled with accelerating technological change and shrinking product lives, create a need to increase speed and degree of production innovation to remain successful, (Harryson 1997b). The criteria for success in this industry according to (Harryson 1997b, Eisenhardt and Tabrizi 1995), Abduh and Skibniewski 2002), is rapid product development, enhancement and cost reduction**.** For this reason, the Japanese companies have been so intent on accelerating product development times, Hamel and Prahalad (1996). Stalk and Hout (1990) argued that it was possible for some firms in the digital information industry to find the shortest possible course from product concept to market reality and positioned themselves to capture a slice of future revenues. They developed an integrated technique of designing and building new products to achieve this.

O'Driscoll (2002), argued that the digital industry is successful because its integrated approach is based on applying two principles; namely Restructuring the product design process (PDP) and Establishment and functioning of DFM team. During the first principle of restructuring, DFM checkpoints are positioned within the product definition, development and validation. A series of questions are answered. In the second principle, the manufacturing engineering team and quality representatives (who participated in the first stage and are fully familiar with the historical database and have discussed issues of manufacturability) will be able to concentrate on developing the product in a focused and enhanced manner. Abduh and Skibniewski (2002) added that Microsoft and Nokia employed the same principle. These firms were able to develop the vision to achieve a lower cost structure and faster development times.

Eisenhardt, and Tabrizi (1995), explained that Hewlett-Packard transformed from an instrumentation company to a computer-based giant through the integration of their core competencies into a new product development process.

Similarly, Intel changed from a memory company to a microprocessor firm through the application of DFM principles in their product development process. Hamel and Prahalad (1996) reported that Motorola's competence in fast cycle-time production rests on a broad range of underlying skills. These include design disciplines that maximize commonality across a product line, flexible manufacturing, direct participation between product engineers and manufacturing engineers, and use of automation and CAD. However, and as argued by (Hamel and Prahalad 1996), a

clear understanding of current and potential markets must drive R&D efforts. They argued that IBM, Apple, Compaq, Hitachi, AT&T Motorola had different approaches to move rapidly from product concept to product development. It was the philosophy of combining skills and resources with team work that extended the process to include the suppliers' network. Citing Vesey (1991), Eisenhardt, and Tabrizi (1995), reported on a study conducted by Vesey of high-technology products that products that were six months late in entering the market, but were within budget, earned 33 % less over a five-year period than if they were delivered on time. Furthermore, entering the market on time, even 50% over budget, reduced a firm's profitability by only 4% for that product.

In his investigation of both CANON and SONY firms, (Harryson 1997a) reported that both companies use a combination of external and internal networking mechanics. These identify and acquire key technologies and related skills, deliver new products in a very short time, gain market knowledge, improve the results of internal R&D efforts, and ensure the successful transfer of these results to efficient production processes. Both companies apply design for manufacturing technique. It can be described in terms of research for design and manufacturing D&M. At CANON and SONY research mainly consists of building a product prototype until it works. Design usually implies the designing and development of a manufacturing process that can produce a perfect copy of the prototype. D&M runs and develops the trial manufacturing line until quality, speed, and costs are acceptable. Harryson identified four key mechanics underlying successful product innovation at CANON and SONY:

1. Strategic training and job rotation for engineers between design and factory
2. Application driven R&D.
3. Direct transfer of development teams from R&D to production.
4. Extensive networking with external centres of excellence and key suppliers.

He added, both SONY and CANON have a corporate culture that promotes cooperation and open sharing of ideas of both R&D competencies and results. This increases their innovative impact across labs and business unites. Harryson reported on what one senior CANON researcher said:

> *" Some of our engineers go to our labs in Australia five to six times a year. This lab strongly supports our development of software simulation programs*

> *and interface electronics. Our R&D labs in the US and UK also give us some support on these fields."* (Harryson 1997b, 291)

Harryson concluded that both companies succeeded because their corporate infrastructure resonates with the, investment in technologies, and human resources, both within and between business units. Design and manufacturing work concurrently and in harmony.

3.9.3 Design and Build in the Automotive Industry

Literature review revealed that the automotive industry provided significant educational opportunities for the construction industry (Latham 1995). Nihtila (1992) argued that using simultaneous engineering the design and manufacturing of the products are no longer separated, physically and time wise, but integrated and synchronized. This face to face cooperation between designers and producers was a natural way of working in automotive industry. Citing the example of Daimler/Chrysler, Kieran and Timberlake (2004) argued that similar to a building construction, cars are made up of many parts. However, a process engineer divides the car to be produced into constituent *chunks,* or modules*.* Each *chunk* is composed of many parts that are preassembled off the main assembly line.

An automobile manufacturer not only makes cars, it also designs them, (Chakravarty, 2001). They are manufactured to meet various safety standards, business demands and applications. With mounting international pressures, this industry transformed itself remarkably, (Abduh and Skibniewski 2002). The 1980's and 1990's have witnessed a dramatic evolution in new product development processes. Global competition has led to shorter product life cycles, necessitated higher quality, and more products, (Dyer 1996). Many companies including General Motors, Chrysler, Ford, Hewlett Packard, Toyota, Nissan, have responded to these increasing demands by adopting concurrent engineering approaches and Lean production theories, (Eaton 1994). This industry as argued by (Rothenberg, 2005) is viewed by many researchers as a benchmark for the construction industry. It proved to be more successful in understanding the importance of low cost and early launching to market, while sustaining the quality of their products. Cars are designed to be safe and comfortable, (Mortimer 2005a), meet the specific range of clients' preferences, be economical to operate and be affordable, (Rothenberg *et al.* 2005).

In the 1980's the success and foresight of Toyota had become a reference point for many auto making countries, (Sanchez and Perez 2003, Hamel and Prahalad 1996). As Sapuan (2005) has shown the automotive product development has changed from a sequential serial process of design, followed by manufacture, to a more organized concurrent process. Design and manufacturing are considered at a very early stage of design. In his study regarding Jaguar, (Mortimer 2005a) revealed that car manufacturer evaluates a technology roadmap to assess future manufacturing processes. Mortimer (2005b) argued that the aim of the automobile industry is to find processes that are fast and cost-effective. Chakravarty (2001) studied the overlapping process of design for manufacturing approach in the automotive industry as influenced by design uncertainty and their impact on time and cost. Chakravarty developed an overlapped D&B model as shown in **Figure 3.11** with an overlapped design and build cycle and variations to it in three different ways namely:

- Interrupt Build Mode (IB).
- Continuous Build Mode (CB).
- Preempt Build Mode (PB).

Chakravarty discovered that in the IB mode (overlap build cycle) starts after (x) units of design is completed (at Point P). Thus build intervals tB M (x) runs concurrently with the design interval tD(w-x), tBM (x) $\leq$ tD(w-x). Similar findings were noticed for CB and PB. Mortimer (2005b) summarized the main objectives that many automakers have established and continually improve on:

- To produce the same value more economically.
- Understanding what business we are in, what we are delivering to clients.
- What assets and skills are critical, and who our competitors are.
- Find a much more efficient way to deliver a particular service.
- Partner with a specialized supplier networks.

Hamel and Prahalad (1996) noted Honda's effort. It was capable of developing new car model that is well engineered in terms of all-round engine performance in a fraction of the time. They added that this is not just Lean manufacturing, it is lean everything.

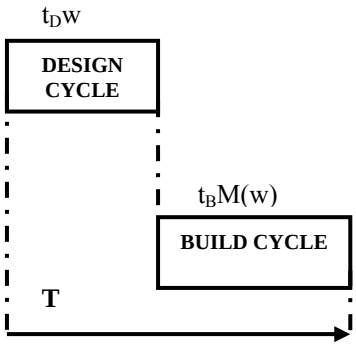


Figure 3.10a. Non Overlapped Design and Build Cycle.

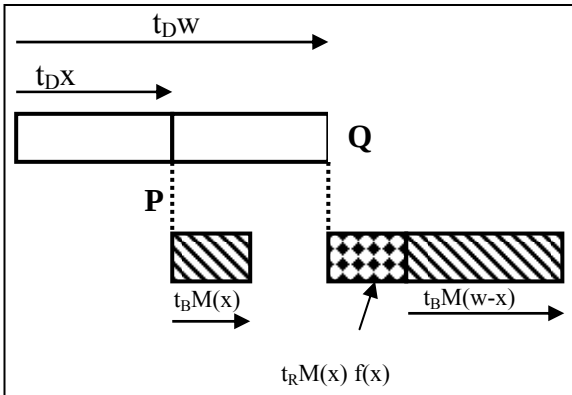


Figure 3.10 b. Interrupt Build Overlapping

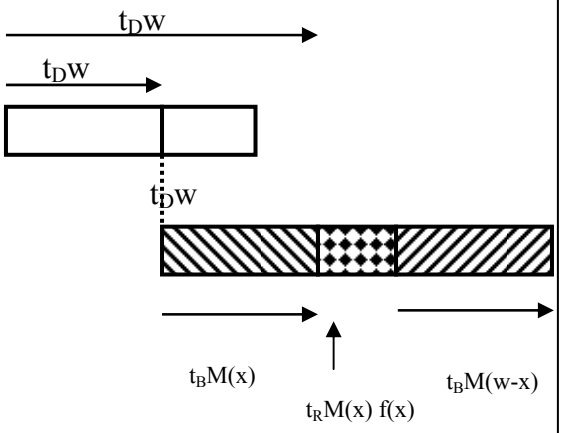


Figure 3.10 c. Continuous Build Overlapping

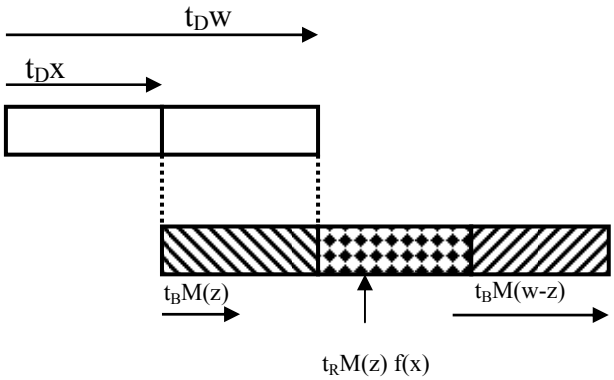
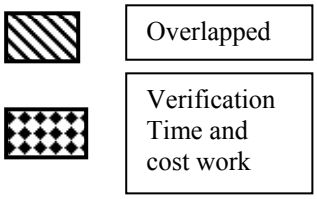


Figure 3.10d. Preempt Build Overlapping.

Modes: M = mapping function
w = units (standard hours)
tD = actual time taken
tB = actual time to build
T = time to complete project
T= $t_Dw+t_BM(w)$ Time
C= $c_Dw+c_BM(w)$ Cost

Source: Chakravarty (2001).



It was also possible for Ford and GM to pursue leadership in a set of discrete technical areas, including engine controls, variable valve timing, advanced materials, and combustion engineering by working closely with specialized supplier networks, (Dyer, 1996).

Toyota, the Japanese auto maker, realized that to compete with US auto makers, the new and formidable competitive weapons would be to produce a quality car with many varieties, produced at half the rival's cost and in half the time (Liker and Meier 2006). This required creativity, imagination and collaborative effort between design

and production engineers. The result was the Lexus. Toyota starts a new model launch with a pilot team from all departments. They coordinate the input and views of each member of the organization. It has developed Toyota Production System (TPS) Built- to-order when the customer wants it, Just In Time, (JIT). They efficiently allowed the company the capacity to Invent, Make, and Deliver in a much shorter time than the competitors.

3.10 Benchmarking the Construction Industry to other Industries.

Sir M. Latham (1994) and Sir J. Eagan (1998) suggested benchmarking the construction industry to the manufacturing and auto industries. This will encourage the construction industry to invent new methods of working to achieve quicker, better, safer and cheaper projects. Lam *et al.* (2004) observed that benchmarking use has been limited in the manufacturing industry. Koskela (2003) noted that reported success of this approach in many industries has spurred more interest in the D&B approach in the construction industry. O'Driscoll (2002), Sanchez and Perez (2003), lam *et al.* (2004) added that the manufacturing industry has been a reference point and a source of innovation for the construction for many years. To a large extent, the idea of industrialization comes directly from manufacturing (Howell and 1997). Computer integration and automation also have their origins in manufacturing. Their implementation is well ahead of construction. The automation has been the key to success in product development, virtual engineering, and simulation. Speed in product innovation using tools like CAD was studied by a group of scholars including (Eisenhardt and Tabrizi 1995, Mortimer 2005b). The CAD use in prototyping and making multiple design iterations accelerates product design. It compresses the schedule and reduces overall cost. Wu and Cheng (1997) observed that in the last ten years Computer Aided Engineering (CAE) has been used to develop crash simulation in addition to prototyping. The use of CAE has substantially lowered costs and reduced time to market. The recent development of the Building Information Modelling (BIM) software for communicating design ideas across all design disciplines was derived from the manufacturing industry to simplify construction techniques, (Mortimer 2005a). The manufacturing industry used this virtual simulation technique for decades as a vehicle for collaborative work between production teams in the work shop and design engineers in the labs.

3.11 The Local Perception and Operating Environment with D&B Option.

Critics of the D&B delivery option from the Saudi construction industry date back to more than two decades. Al Mansouri (1988) found out that the local consulting firms avoid the involvements of the contractor with the design. He reported on what these consultants claimed as follows:

> *"The earlier involvement of contractors could be risky and disturbing as contractors generally tend to simplify the design and influence the constructability of the project which in turn, will lead to higher financial profit".* (AL Mansouri 1988, 118-9)

Al Mansouri also reported that Saudi clients were against D&B contracting because D&B yielded inferior quality. Bubshait and Al Musaid (1992) conducted a survey aimed at studying the public sector clients involvement in construction projects in Saudi Arabia. They stated that unless these major clients become more involved in the entire process of the project lifecycle the construction industry will have a sluggish growth and development. Al Khalil and Al Ghafly (1999), Ubaid (1991) reported that for the construction industry to improve its performance and productivity it needs to rethink many of the accepted terms that are taken for granted for decades. This includes the use of the D-B-B traditional procurement system. Al Khalil and Al Ghafly (1999) proposed that serious consideration should be taken by the government authorities to initiate a change from the traditional project procurement strategy. This includes implementing more projects using a D&B procurement strategy. Jannadia *et al.* (2000) conducted a study regarding the contractual method for dispute avoidance and resolution (DAR) in Saudi Arabia. They studied the allocation of fair contract risks and the drafting of dispute resolution clauses in the Saudi construction contracts for D.B.B and the D&B contracts. They reported that many clients draft their construction contracts so that the submission of a valid claim is nearly impossible. They concluded that:

> *"An equitable contract serves as the first step in building cooperation and close coordination among the project participants for working out the inevitable disputes before they lead to divisive claim that negatively affects the schedule and construction cost."* (Jannadia *et al.* 2000, 42)

Abdul-Hadi *et al.* (2005) called for the Saudi construction industry to re-engineer itself to achieve simpler cost control and for better coordination and integration.

Alhazmi and McCaffer (2000) reported that the Saudi public sector clients are the main users of the D&B project procurement option. The government utilized this project delivery option for completing major public amenities including; airports, ports, universities, ministerial buildings, defense projects and the expansion projects of the Two Holy Mosques in Makkah and Madenah. At the time, the D.B.B option proved to be inadequate in meeting the public sector's requirements.

As stated in Chapter Two, Alhazmi and McCaffer (2000) developed a Project Procurement System Selection Model (PPSSM) to assist the Saudi government agencies in selecting the appropriate procurement system for implementing their projects. Jaweed (2004) also developed another D&B procurement selection model which comprises a software tool model with guidelines for the selection and implementation of D&B method based on seven distinct phases. In response to the increased concern from the local construction industry stakeholders, The Saudi Chamber of Commerce and Industry Council organized a real estate property conference in March 2007. It was sponsored by the Saudi Crown Prince and was aimed at achieving five significant objectives, the two most important were:

1. Draw the public attention to the fact that the construction industry is a major contributor to the national economy, following the oil and gas sector. This sector is worth $200 billions (Two Hundred Billion US Dollars).
2. Invite the local universities to devise new programs concerned with finding ways for developing effective construction and to provide the means to deliver projects within the shortest possible time and for least cost.

Earlier in chapter Two we discussed the rapidly changing characteristics of the Saudi construction industry's working environment over the last 20 years. The construction boom and inflation has caused construction costs, particularly material costs to escalate. Thus, it has become important to find ways to complete a building within the client's established budget and the shortest time possible. D&B and its close ally, fast track delivery, stood up as potential answers. The successful examples in the Gulf areas set the yardstick for the speed of accomplishing large scale projects. Saudi developers and investors who are the major investors in Dubai real estate market, MEED (2006), have been closely monitoring activities in Dubai.

The positive results have provoked the local industry major organizations to consider and utilize D&B procurement. MEED (2005), reported that SAUDI ARAMCO is expecting bids from international contractors in September 2005 on an estimated

$100billion onshore oil field development using D&B Engineering, Procurement and Construction (EPC). In August 2009 and the Public Pension Agency (PPA) awarded forty (40) high rise towers within King Abdullah Financial District to six firms on D&B option. The completion of these towers is within thirty months (PPA Annual Report (2009). A quick project delivery was a necessity, not a choice. The driving factor in the decision was how fast could it be done, speed of delivery as opposed to the concern for implementing D&B. The author collected the following data shown in **Table 3.3** that shows the magnitude of D&B projects awarded to four, well known, local contracting firms who participated in the survey interviews. The figures clearly show an increase in demand for D&B project option. The review of pertinent literature for the last three decades as demonstrated by (Jaweed 2004, Al Hazmi and McCaffer 2000, Al Khalil and Ghafry, 1999, Amjad 1998, Assaf *et al.* 1995, Al Mansouri 1988, Al Jarallah 1983, Rehemi, 1983) indicates that the local perception and operation mode about D&B project procurement process appears to fall into three categories. These categories cover unfamiliarity with D&B option, lack of procedures and tools to manage D&B procurement option, and lack of phased approval process by the local authorities.

Table 3.3. The Value of D&B Projects from Four Leading Contracting Firms in Saudi Arabia

#	Firm	Value of D&B Projects in SR Bn				Remarks
		2006	2007	2008	2009	% of Total Construction Value in SR Billion
1	SOL	5.3	6.1	9.0	11.2	between 20 to 30%
2	SC	1.0	2.1	4.3	3.1	between 15 to25%
3	SBG	12.4	15	22	27	between 35 to 50%
4	ELS	1.6	1.9	2.8	7.1	between 20 to 35%

First, according to (Al Mansouri 1988, Assaf *et al.* 1995) the Saudi construction industry is not aware of an accepted definition of D&B project delivery option. The majority of the industry stakeholders did not have enough exposure to this project delivery option. This explains the lack of popularity within the industry. Amjad (1998) reported about the lack of trained local project manager capable of managing D&B projects. Jannadi (1997) observed the lack of procedures and tools that aid the Saudi project managers to properly plan, organize, and manage the D&B projects. Reasons for this phenomenon came from (Alhazmi and McCaffer 2000) who argued

that Saudi clients were not familiar with D&B contracting and the impact of this project delivery option on the project's cost and quality. Jaweed (2004) added that the local consulting and contracting firms were mainly familiar with the traditional D.B.B procurement path, attitude, and culture of work. The D&B strategy would necessitate a major change in their organizational structure and would force them to acquire additional expertise which was not readily available.

Second, the majority of the D&B projects in Saudi Arabia that were procured over the past three decades by international consultants/contractors were managed under international contractual agreements. Many of these international firms left in the mid 1990's and did not leave D&B project management tools, systems, procedures and techniques. Consequently, the interpretation and application of the D&B procurement is not well controlled and managed (Jannadi, 1997). Some contractors now use D&B concept to win new projects by tempting clients with a quick and speedy delivery of projects according to (Jannadia *et al.* 2000).

Finally, because the traditional D.B.B project delivery option contracts have been around for decades, the local insurance companies, courts and legal bodies have had the opportunity to interpret this form of contracting well. The binding insurance issues were understood. Public sector clients, as reported by (Al Kharashi and Skitmore 2009) continue to follow the purchasing contract regulations mandating that public projects be tendered publicly along the D.B.B path. This limits the use of D&B contracting. Jaweed (2004) reported that there are two other D&B private sector Saudi clients who procure D&B projects:

I The first group who contract using D&B is only concerned with initiating construction as early as possible. Their objective is to have the foundation package started. Hence, many sites were excavated and remained empty for months. This phenomenon has caused major embarrassments to the local authorities. As a result, the authorities stopped issuing phased construction permits unless the applicant had proof of a signed contract to build the entire project, (Riyadh Municipality Building Rules and Regulations 2007). In addition, the building permits now have a time limit of twelve months for starting the site activities. The conditional approval of any building permit has limited the number of excavated sites. It has stopped the undisciplined approach and misuse of the D&B method.

II The second group of clients are mainly developers who develop their own contractual bespoke D&B contracts. These contracts generally set unrealistic targets for the delivery of design packages to site. This client group knows little about D&B approach. They wish to package the design work with the construction and sell the property immediately. They only care about first capital cost and not the total project life-cycle cost. They condense the design and project schedule in order to have an earlier occupancy of the facility.

The literature review clearly demonstrates that there are impending changes in the construction business environment in Saudi Arabia. Clients, contractors, policy makers, and consultants alike, are aware of the pitfalls of the traditional D.B.B option with respect to delays, disputes, and cost over runs. A procurement method is made attractive if it addresses the concerns of the industry stakeholders with respect to:

1. The industry clients' concern for speed and certainty of delivery on time and on budget and meeting expected quality standards, and void of undue risk.
2. The consulting firms' concern for scope definition, setting realistic schedules, establishing appropriate insurances coverage, being treated as equal partners within the D&B team.
3. Contractors' concerns with respect to scope definition, client's knowledge of the D&B contracting method and their decision- making process, and being allowed to participate in the design process.
4. Government authorities' concern for objectivity and accountability in delivering projects of high quality and yet at the lowest cost possible.
5. Insurance companies' concern for how to respond to providing adequate insurance policies for all parties of the contract with clear definition of their respective liabilities, and claim resolution procedures.
6. Investors and developers' demand for faster, and cheaper delivery of projects.
7. Absence of cultural barriers separating consultants, contractors and clients
8. Clear legal and contractual arrangements.
9. Flexible building permits process with clear rules for construction.

Factors such as the market conditions, cost of capital funding, delays in the construction, and sophisticated project types have influenced the decision of many industry stakeholders to seek a faster project procurement method. The above and other factors are investigated in chapters five and six respectively.

3.12 Summary

This chapter demonstrated that the D&B project delivery approach has its roots in ancient civilizations. The approach was known as the Master Builder, where a single source had absolute accountability for both design and construction. It is successfully practiced across many industries including the manufacturing, automotive and digital industries. Concerns for selecting the appropriate project procurement system for each individual project were discussed. Research revealed that for the past three decades, the use and interest in the D&B contracting approach in the USA and UK has greatly accelerated. D&B contracting forms were discussed and presented. Better results were found to be achieved if selecting and awarding the D&B contract is based on best-value approach using multiple criteria for contract award.

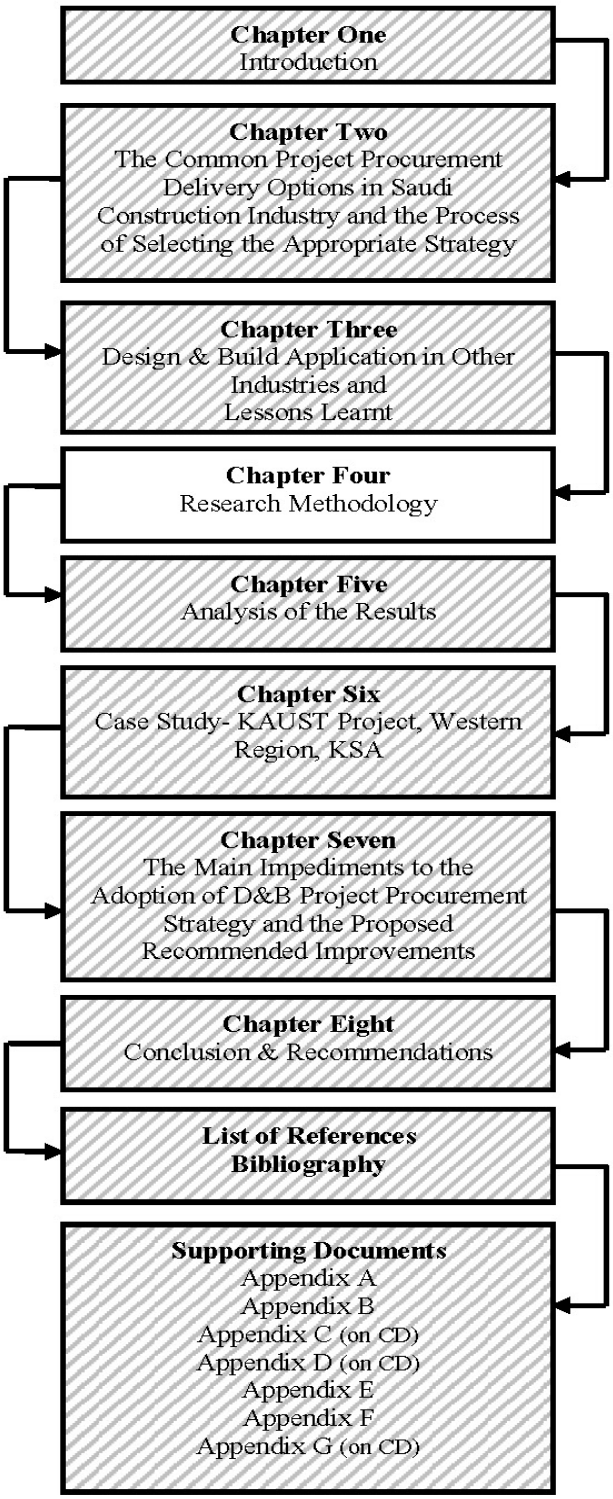
Critics and proponents of D&B project delivery system use the same criteria for judging the effectiveness of this approach. Opponents of D&B option argued that this strategy can be risky, complex, full of uncertainties, and if not properly implemented can lead to conflict, poor quality and disputes.

Proponents to D&B contracting on the other hand, argue that if properly managed, D&B project procurement option can deliver projects faster and within the quality and cost constraints. Research review demonstrated that benchmarking the manufacturing, automotive and digital industries proves to be essential. For these industries, the separation of design from production is neither the norm nor the practice. They are integrated and synchronized.

In Saudi Arabia, many government agencies and industry practitioners have expressed their concern with current state of the Saudi construction industry's performance and the reported delays in delivering projects. Industry stakeholders demand better project planning, resolution of increased projects risks and contractual disagreements, and measures to curb the high cost of construction.

Today, speed is of the essence, product life cycles are getting shorter, and customers expect instantaneous service. This chapter demonstrated that since 1990s the demand for D&B contracting is increasing but in the pace to catch up with the construction boom. It is where architecture, engineering and construction come together. It is fuelled by the information age technology and the demand for sustainable design in order to survive. The next chapter will discuss the research methodology selected for this study and the method employed to investigate the research problem.

Chapter IV
Research Methodology.



4.1 Introduction

Preceding chapters discussed project delivery options available and practiced in the Saudi construction industry and how the traditional procurement option has dominated the industry for decades. The construction boom in the entire Gulf Region since 2004 has mandated consideration for other innovative project delivery options such as D&B contracting for faster, quicker and quality projects. This chapter reviews the available research paradigms in the construction industry and presents the method used to investigate the impediments to the adoption of D&B project delivery strategy in the construction industry of the Kingdom of Saudi Arabia.

Given the exploratory nature of this study, the selection of the mixed method research strategy employing both qualitative, grounded theory and quantitative approaches in a single study, is defined as the appropriate strategy to answer this research question. The methodology and procedures are identified to present source of data, collection procedures, nature, and content analysis to provide answers satisfying the objectives of this study. **Figure 4.1** illustrates the process established in order to select the appropriate research method for this study and the course of action taken.

4.2 The Research Study Problem Definition

Chapters two and three identified the problems associated with the traditional project delivery system internationally, and in the Saudi construction industry. Moreover, the literature review confirmed that the continued use of the traditional sequential project delivery system has been criticized for causing delays and cost overruns problems in the Saudi construction industry. Efforts to improve productivity of the Saudi construction industry date back to the 1980s when Saudi scholars, researchers and academics called for other project delivery systems such as Design and Build (D&B) contracting. Despite these demands, the traditional project delivery system still dominates. There seems to be some resistance to adopting D&B contracting within the local working environment. The extent of the problem as stated in chapter one and its content can be summarized as follows:

> *"There are existing impediments to the adoption of D&B contracting in the Saudi construction industry. Saudi clients are demanding a much quicker project completion schedules that are also cost effective, D&B project*

delivery system is still considered an unattractive contracting strategy by many industry participants. Unless the D&B option is adopted, the continued practice and dominance of the traditional delivery system will hinder any serious improvement to the industry. Consequently, the industry will fail to satisfy its varied stakeholders".

THE PLAN AND PROCESS FOR SELECTING THE APPROPRIATE METHOD FOR THIS STUDY

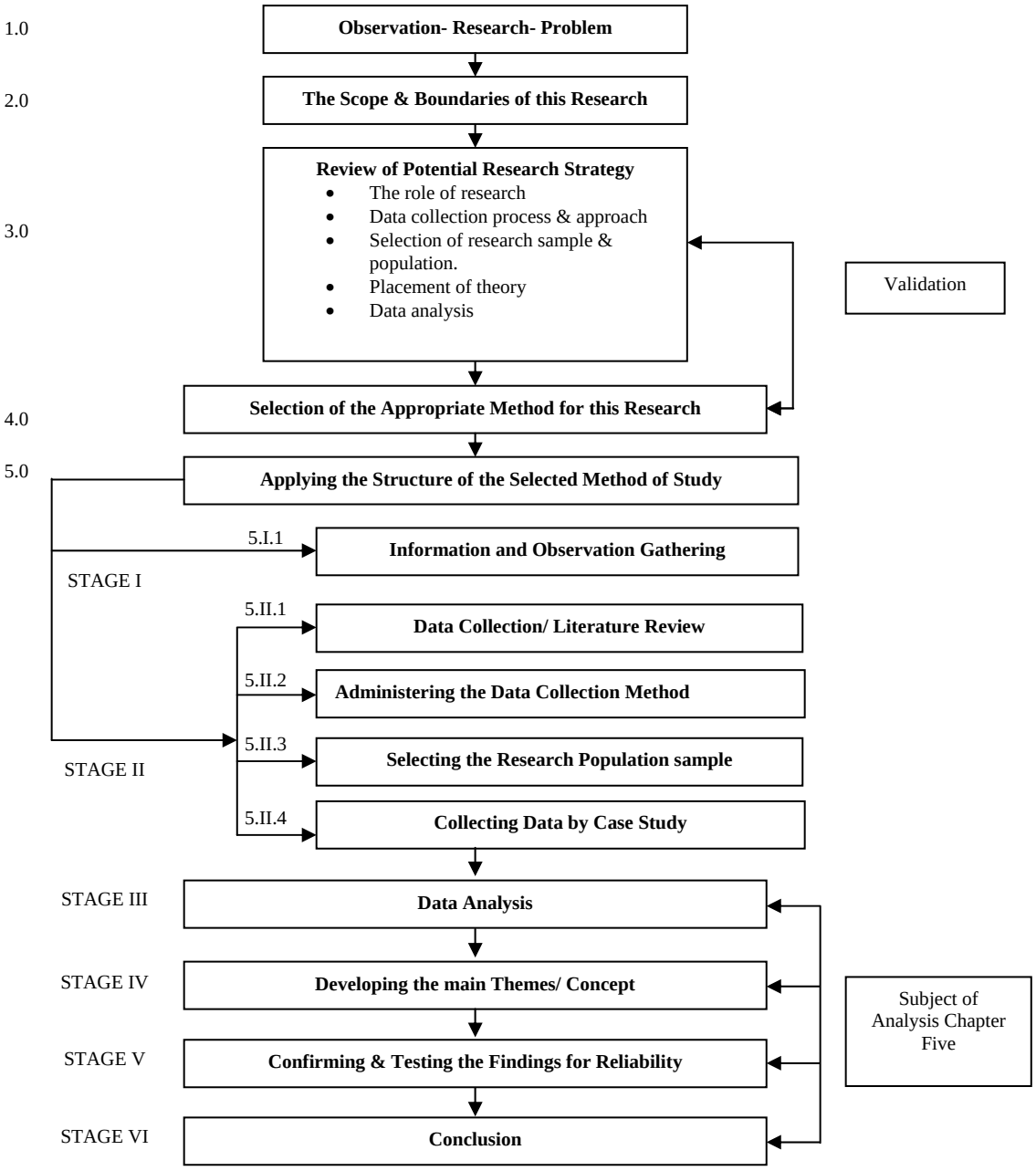


Figure. 4.1. The Methodology Employed to Select the Appropriate Research Method for this Study.

4.3 The Scope and Boundaries of this Research Study

The nature of this research problem considered several aspects including lack of general knowledge and awareness, cultural, political, financial, and social. It needs to have a broad approach to better capture and understand the holistic view and attitude of key industry stakeholders regarding this research problem. Hence, since limited amount of knowledge about the research topic is available, the scope of this research study was exploratory in nature. This study does not begin with a preconceived theory or concept in mind. This need provided some guidance to how the research methodology would be selected. The preceding chapters established that the adoption of the D&B contracting within the Saudi construction industry was not studied in depth. This study therefore, is among the first few studies to examine this problem and substantiates the need to adopt a piloting format and scope to capture a wider angle of this research investigation. As a result, the scope of the study focuses on:

- Reasons for the dominance of the traditional project procurement option in the Saudi construction industry.
- Define the impediments to the adoption of D&B contracting, whether they are cultural, political, technological, lack of knowledge or regulatory.
- Factors that would make the Saudi construction industry participants accept adopting D&B option and what changes to the current contracts and regulations are required.
- What prevents the main industry participants (consultants and contractors) from adopting D&B project delivery option at a wider scale?
- What is the common level of knowledge regarding D&B contracting amongst the various industry stakeholders (Public and Private sectors, Real-Estate Developers, Manufacturers, Real-Estate Market Financial evaluators) and the consulting and contracting firms in particular?
- Solution and proposals that would make D&B contracting an attractive delivery option. Inviting the public sector to initiate this change.

The challenge was to define, select, meet and interview a wider sample population who could provide a deep and narrow focus on the reasons behind those impediments and propose solutions to them. To supplement the direct interviews and the investigations, with a wide range of industry participants, this study included the analysis of one case study, as recommended by (Silverman 2005) in such situation.

The following sections present a review of the available research methodologies and present the selected method for this study.

4.4 The Nature and Meaning of Research

Research is scientific, it provides the foundation for, reports about, and representations of "the others" (Denzin and Lincoln 2005). Research goes beyond general description of events and concepts. It is the act of investigating for new discoveries to add knowledge or improve, expand, and advance existing concepts, meanings or sets of understandings. Pugh (1998), defined research as:

> *"The act of finding something you do not know and to reorient our thinking, to make us question what we think we do not know, and to focus on new aspects of our complex reality"* (Pugh 1998, 45).

According to (Marshall and Rossman 2006) a good piece of research seeks to answer specific questions, solve a particular problem, explain or extend an understanding of a particular phenomenon. Phenomenology is also defined as the art or practice of "letting things show themselves" (Husserl, 2001). Creswell (2003) indicated that a solid piece of research involves a good theoretical base and a clear and defined methodology and strategy of inquiry. It must have some distinguishing characteristics to make it truly scientific. All research findings must be able to be tested and valid for generalization to a broader population. Silverman (2005), Goulding (2002), Buckley *et al.* (1995) reported an operational definition to research that requires the satisfaction of a number of conditions. It can be concluded that a sound research must have the following characteristics including:

a) The orderly investigation of a defined problem.
b) The use of appropriate scientific methods.
c) The gathering of adequate and representative data.
d) Having logical reasoning uncolored by bias being employed in drawing conclusions on the basis of the evidence presented.
e) A demonstrable proof of the validity or reasonableness of the conclusions.
f) The cumulative results of research in a given area should yield general principles of laws that may be applied with confidence under similar conditions.

Sekaran (1992) defined this scientific enquiry process as a continuous, overlapping process looking for explanation, relationships, comparisons, predictions, generalizations and theories as shown in **Figure 4.2.** Scientific research has been traditionally classified into two primary types; Pure and Applied.

The pure research supplies the theories whereas the applied, or action research uses and tests them. This distinction was found to be rigid by some researchers including (Marshall and Rossman 2006, Pugh 1998) and they proposed that these two basic types be classified into threefold classification of research namely: exploratory, testing and problem solving. They argue that classification of both quantitative and qualitative research and the mixed method which is a combination of both methods.

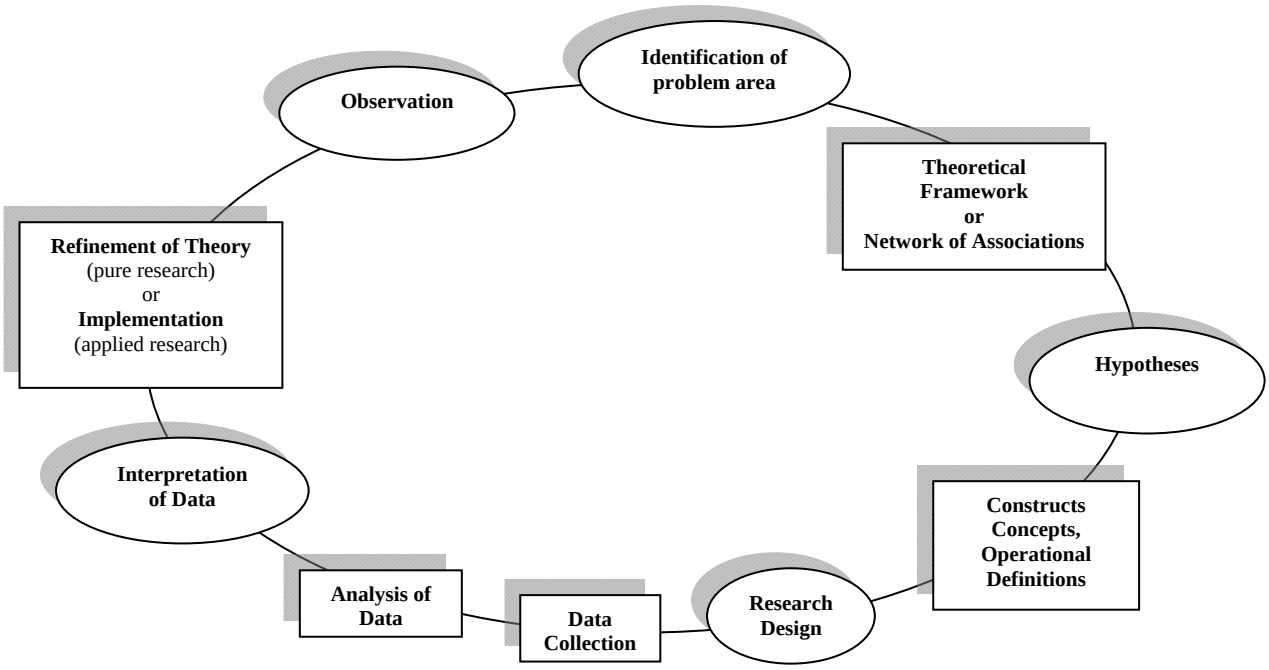


Figure 4.2. The Building Blocks of Science.
Source: Sekaran (1992)

Silverman (2005), and Creswell (2003), added another observational type, which is the Ethnographic. These four types can be summarized as follows:

1. The exploratory type is concerned with taking a new problem about which is little known. The researcher will redefine and modify the research problem as the study develops and more data becomes available. The structure of the research will not be defined from the outset.
2. Testing-out research challenges previously developed theories and or hypothesis. The research method is iterative, uses both inductive and

deductive logic to redefine or provide new description or patterns, modify or improve a theory or previously established generalizations.

3. Problem solving research or action research, the researcher is an observer; he or she defines an actual problem 'in the real world' and considers all means and resources to find a practical solution to it. The research problem is known and the strategy of inquiry and method of solution has to be discovered.
4. Ethnographic research is observational and it studies social, scientific relationships and events between people. The researcher is actively and personally involved with the organization under investigation and studies and interprets their actions, perceptions and behavior. Grounded theory is the common outcome of this type of research.

Since, as argued by (Silverman 2005, Creswell 2003, Goulding 2002) there is no single standard research method appropriate for every research study, considerable assessment was made in the literature review to select the appropriate research methodology that would best guide this study and provide the framework for answering the research question. The following sections present a brief review of the literature on research methodologies.

4.5 Review of Potential Research Strategy

Although personal training, past experience and preference may dictate the final decision in choosing a methodology, many researchers including (Naoum 1998, Raftery *et al.* 1997, Morse and Field 1995) advocate that these factors should not blind investigators to other options. Therefore, the research study objectives that would influence the appropriate methodology selection for this study are:

1. The need for flexibility and freedom to investigate and explore a phenomenon in depth; define the impediments related to the adoption of the D&B contracting in the Saudi construction industry.
2. Allow investigation, to go broadly at the nature of the problem with the ability to have different types and sources of data and to narrowly focus during the research process to establish themes, concepts and their relationships.
3. Be able to gather, compare and integrate data, and findings form both quantitative and qualitative data using inductive and iterative techniques to transforming data to draw inferences.

4. The flexibility to accommodate potential changes in direction and scope to include emergent ideas and concepts that can be related to cultural, political, social, financial or educational factors, mandating that the methodology that would allow these factors to be exposed and identified.
5. Allow data collection and analysis to begin with the first interview which will then inform and lead to the next interview.
6. Provide the procedures and tools to interpret, and transform the data and draw inferences to provide answers to the research question(s).

The literature review revealed that there are three main research methods or approaches that dominate the research work these methods are:

- Quantitative method,
- Qualitative method and
- Mixed method.

Many writers including (Teddlie and Tashakkori 2009, Bryman 2006, Silverman 2005 Sekaran 1992) studied these three approaches and argued that there is no primacy of one method over the other. Each approach is appropriate in its own right for a specific problem and under specific conditions, as long as, the research objectives are clear and the approach is well defined. Sekaran argued that there should be some "purposiveness" in scientific research and researchers must have a definite aim or purpose for research. Bryman (2006), advocate that the three approaches have some distinguishing characteristics to make them scientific and their findings are testable.

The last three decades have witnessed extensive debates about the merits and demerits of these three methods or paradigms, as referred to by (Creswell 2003, Raftery *et al.* 1997, Seymour *et al.* 1997, Seymour and Rooke 1995). The three approaches attempt to investigate, explore or develop a new or existing concept, theories, with the aim of expanding the level of existing knowledge. A brief review and appraisal of each method is provided in the following section, highlighting the key research defining features and functions as defined by (Teddlie and Tashakkori 2009, Silverman 2005, Creswell 2003, Strauss and Corbin 1998) and stated below:

- The role of the researcher.
- Data collection sources, types of data, and procedures and instruments.
- Selection of the research sample and population.

- Placement of theory.
- Data analysis and reporting findings.

4.5.1 The Quantitative Method

Quantitative research is objective in nature and embodies the basic principles of scientific investigations. This method according to Creswell (2003), is iterative, and can be traced to the time of Aristotle when he challenged the principles of science. This method tests a theory or a hypothesis composed of variables, measured with numbers that analyzed with statistical procedures identifying whether the theory or hypothesis holds true under different circumstances. It is tightly structured (Creswell 2003) uses statistical analysis to provide quantitative description of trends, attitudes or opinion of a selected population.

Many writers including (Silverman 2005, Goulding 2002, Raftery *et al.* 1997) described this method as courageous, dealing with hard facts and making hard decisions based on experimentations, testing or re-testing and verifying theories and assumptions using mathematical computations. The contribution to positive knowledge led a group of writers to refer to this methodology as the positivist paradigm. Silverman (2005), Guba and Lincoln (2005) defined positivism as the model of research process treating social facts as existing independently of the activities of both participants and researchers. Thompson (1993) described the characteristics of the physical sciences mirrored in the positivist paradigm as:

> *"A common logic with the physical sciences reflected in the experimental and quantifiable variables which can be manipulated to identify relationships, as the model for social research and establishment of universal laws which are characteristics of explanations of events derived from deduction and statements of regular relationships between variables which hold constant across all relevant circumstances"*(Thompson 1993,14)

In their study of the culture of research Seymour and Rooke (1995) described the quantitative approach as the rationalist and scientific paradigm, primarily concerned with causality rather than meanings and judgment of "is" or "is not". They argued that the two assumptions of this paradigm are:

1. The distinction which is drawn between subjective experience and objective reality.

2. The assumption that the correct way to describe and analyze a situation is through the employment of causal explanation.

More recent writers added that this approach is largely based on a well-developed research question, and often examines the relationships between and among variables in order to answer a central question or test a hypothesis, Creswell and Garrett (2008).

4.5.1.1 The Role of the Researcher

In quantitative studies the researchers are not expected to be personally and directly involved with the study participants and the subject under investigation. This according to (Naoum 1998) includes a study of the source and type of data required, primary or secondary, the population sample and characteristics, the data collection procedures and instruments used that could include collecting data through a survey or experimentation. The researchers perform the analysis with the objective of either test or expand a theory or develop a new meaning to existing concepts. The researchers are expected to maintain a high level of objectivity and sensitivity in handling the data generated from the study. As argued by (Creswell, 2003) it is essential to control against bias intrusion and maintain credibility of the findings.

4.5.1.2 Data Collection Process and Approach

The options available for data collection methods include a survey approach by means of questionnaires, direct interviews, historical reviews, experimentations, and measurements. The chief and most commonly applied option is the survey method. The questionnaire instrument tends to use a standard structured format of questionnaire as a model and procedure of strategy of inquiry. Data collected are considered as primary data and usually require numerical analysis. The results and findings of the analysis are then tested for validity, accuracy reliability before they can be generalized. A sample is normally selected from a large population allowing inferences to be made to wider populations (Silverman 2005, Creswell 2003). The survey can be both cross-sectional, with the data administered and collected in one specific period of time or longitudinal with data collected over a span of time. Administering the data collection can take many forms:

- Self –administered questionnaire or by post.
- Interviews. Direct or via telephone.

- Structured record reviews to collect data from documents.
- Structured observations.
- Electronically, through a Web-based online survey.

The choice of one approach over another depends on many factors including, time, cost, availability of respondents, geographic locations, and convenience. For mailed survey, steps for administering the survey are required to ensure a high rate of response. Silverman (2004) suggested a four-stage phased approach where the researcher issues an advance notice to the potential sample participants followed by the actual issuance of the survey material. The third stage is when the researcher issues a postcard a week after the issuance of the actual questionnaire. The fourth mail-out consists of a personalized cover letter with questionnaire and preaddressed return envelop with postage to all non-respondents.

4.5.1.3 The Research Sample and Population

The characteristics of the selected population sample are an important component of this approach. The size, type and selection procedures of the individuals are all critical to the validity and generalization of the findings. Sampling procedure can be a single procedure where the researcher would have access to names in the population and sample the individuals directly or a multistage or clustering. Citing (Babbie 2001), Creswell (2003) advocates that clustering is ideal when it is impossible to compile a list of the elements composing the population. In a multistage procedure, the researcher first samples groups or organizations, obtains names of individuals within the groups and then samples within the group. Quantitative researchers tend to select a random sample in which each individual has an equal probability of being selected. This contrasts with the "convenience selection" or "non probability" sample whereby individuals are chosen based on their availability and willingness to participate. Random selection provides greater level of validity and generalizibilty and helps to control against bias. The population sample selection involves the choice of whether stratification of the population is required prior to the random selection of the respondents (Gravetter and Wallnau 2000). Stratification according to (Fowler 2002) ensures that certain common characteristics and proportion of the sample are represented. The sample reflects a true proportion of the individuals and a high degree of homogeneity. Initially, survey researchers conduct a pilot study on few participants and peer researchers to check for content

clarity and identify any shortcoming in the questions. The pilot questionnaire reveals potential problems and shows the rate of non-response. Revisions and corrections will be incorporated based on the feedback. The survey questions directly relate to the variables of the study. They include factual, generic, attitudinal, and other specific questions seeking answers to the researcher. Silverman (2005), Creswell (2003), Naoum (1998), suggest that researchers must consider the following main features and components in the questionnaire:

- Sample items from the instrument so that readers can see the actual items used.
- The major content sections in the instrument shall include cover letter, a useful list of items, i.e. demographics, attitudinal items, factual items, behavioral items and the closing instructions.
- A general information section, a specific information section, a section that deals directly with the issue under investigation, and observations and recommendations. The questionnaire must be designed to provide answers, opinions, and other relevant data about the research problem.
- Explanation to the respondents of the types of scales used to measure the items on the instruments such as continuous scales (e.g. strongly agree to strongly disagree) and categorical scales (e.g. yes/no, rank from highest to lowest importance).

4.5.1.3.1 Data Collection Through Interviews

Depending on the strategy of inquiry adopted, the questions by direct interviews in this case can be structured, unstructured or semi structured.

- Structured interviews include a predetermined set of questions asked in a formal manner and order. The interviewer maintains full control of the questionnaire with many questions having closed ended answers. This provides specific and accurate answers facilitating analysis.
- Unstructured interviews use open-ended questions and general information is sought. The interview does not follow a fixed sequence or set order of questions. The interviewer is looking for a broader range of information about the subject. The interviewee has greater freedom to answer the questions in a broad way.

- Semi structured interview is when the researchers use closed and open- ended questions. It is a combination of the above two modes. The questions are not asked in a specific order.

4.5.1.3.2 Data Collection Through Experiments

This form of data collection experiments with the random assignment of subjects to treatment conditions, as well as quasi-experiments that uses non-randomized design (Keppel, 1991). Research conducted in a laboratory or experimentation environment follows a controlled and strict procedure.

4.5.1.4 Placement of Theory in Quantitative Studies

Theories develop as an explanation to advance knowledge in a particular field.

The process involves conceiving and intuiting concepts and formulating them into a logical, systematic, and explanatory scheme, (Strauss and Corbin 1997). Theories, hypothesis derived from data must, according to (Silverman 2005, Goulding 2002), be continuously reviewed against incoming data, and modified, extended, or deleted as necessary. At the heart of theorizing lies the interplay of making induction (deriving concepts, their properties and dimensions from data and deduction hypnotizing about the relationships between concepts, the relationships also are derived from data). Citing the work of (Kerlinger, 1979), (Creswell, 2003) defined a theory as:

> *"A set of interrelated constructs (variables), definitions and propositions that presents a systematic view of phenomena by specifying relations among variables, with the purpose of explaining natural phenomena"* (Creswell 2003 .120).

Strauss and Corbin (1998) defined the theory as:

> *"Theory is a set of well developed categories that are systematically interrelated through statements of relationships to form a theoretical framework that explains some relevant social, psychological, educational nursing or other phenomenon. The statement of relationship explains who, what, when, where why how and with what consequences an event occur. (*Strauss and Corbin 1998, *22).*

In the quantitative study researcher advances a theory, collects data to test it, and reflects on the confirmation or disconfirmation of the theory by the results. The theory becomes a framework for the entire study, an organizing model for the research question or hypotheses and for the data collection procedures Bouma and Atkinson (1995). Creswell (2003) studied the deductive method and the placement of theory in the quantitative studies and developed a model of thinking stating how the theory is used in either method. **Figure 4.3** shows the deductive mode of research. This according to Creswell means that concepts, variables and hypothesis are chosen from the outset of the study and remain active with the intent of developing a generalization that contributes to the theory. Once a theory has emerged, or developed, it is given a name and used to advance knowledge in a particular field, (Thomas, 1997).

4.5.1.5 Data Analysis

In quantitative studies, the analysis starts after all the data is collected. Testing, retesting, and developing new understandings or models require statistical and numeric data to report the findings. Fellow and Liu (1997) indicated that the prime reason for testing a hypothesis in construction research is to enable the researcher to produce models that indicate the variables postulated in the theory that are hypothesized to interact in a particular situation. Quantitative results are released numerically, usually comprising of tables charts, graphs and matrices and other scales of measurements.

Dependent and independent variables and their relationships are described. The rationale of the findings is provided. Descriptive statistics according to (Silverman 2005, Creswell 2003, Anderson *et al.* 2001, Kothari 1998) are used in quantitative studies to analyze the outcome of the numeric data findings. Values such as mean, mode, median, range variance and standard of deviation are deployed. The first three values are to measure central tendency within the data whereas the last three are for measuring the dispersion or variability within the data.

There are methods for determining the relationships between variables. Other methods for quantitative data analysis include the use of scaling, rating and ranking measurement techniques to analyze the results.

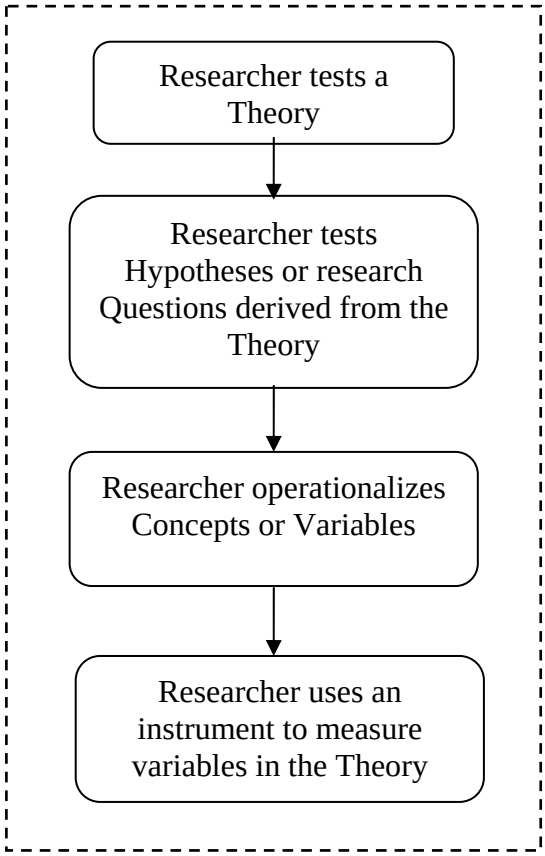


Figure 4.3. The Deductive Mode of Research in Quantitative Research. Source: Creswell (2003)

In case of bivariate population correlation can be studied through:

(i) Chi Square method

(ii) Charles Spearman's coefficient of correlation

(iii) Karl Pearson's coefficient of correlation

(iv) Simple regression equations for cause and effect relationship

For multivariate population, correlation methods available to the quantitative researchers include:

(i) Partial correlation

(ii) Multiple regression equations for cause and effect relationship

(iii) Causal path analysis

All of these methods are covered extensively in the literature materials.

Open-ended questions in quantitative research are classified and grouped under separate categories and sub-categories as appropriate. Conclusions and recommendation are presented together with the final observations, results and findings of the research. Threats to validity, internal and external are to be controlled

and eliminated from the data analysis (Silverman, 2005). Researchers establish and define the measures taken with the instruments to ensure the validity, stability and reliability of the instruments even if used over different times.

4.5.2 Qualitative Research

In contrast with the quantitative research, this research strategy is 'subjective' in nature, involving a personal opinion, view and assessment of a situation or a problem. Qualitative research refers to research that produces findings not arrived at by statistical procedures (Marshall and Rossman 2006).

Qualitative research paradigm as argued by (Miller 1991, Borg and Gall 1989) has its roots in cultural anthropology and American sociology. A fundamental characteristic of this approach according to (Creswell, 2003) is that the design is consistent with the constructivist/interpretive/and or participatory advocacy knowledge claim. Patton (2002) described the qualitative approach as multidimensional, using multiple methods that are interactive and humanistic. It does not entail relationships between a dependent variable and an independent variable, as is common in quantitative studies, because its purpose is not to test hypotheses. The researcher interprets data. Themes or categories are analyzed and interpretations conclusions are made about its meaning personally and theoretically.

Seymour and Rooke (1995), defined this approach as the one where it emphasizes meanings, experience, description and the like. It is a problem solving approach. The information gathering process can be classified in two categories, namely exploratory and attitudinal. The process of qualitative research is inductive, interpretive and the researcher generates meanings and new concepts from the data collected in the field.

Qualitative research is not concerned with measuring numbers and charts and figures, (Creswell, 2003) instead the study explores and analyzes descriptively a real situation. Relevant themes and concepts and eventually generate a theory or a working model are defined to help explain a phenomenon rather than test a theory. Strauss and Corbin (1998) described qualitative research as emergent rather than tightly prefigured. Several aspects emerge during a qualitative study; the research question may change and be redefined as the inquirer learns what and who to ask. Locke *et al*. (2000) added that this method is where the researcher gradually makes sense of a social phenomenon by contrasting, comparing replicating, and classifying the object of study.

4.5.2.1 The Role of the Researcher

In qualitative research, researchers involve their participants in data collection. Data is collected in close proximity investigation, which yields intense and prolonged contact with the situation or area of the study. The researcher is the primary instrument in data collection rather than some inanimate mechanism (Marshall and Rossman 2006, Patton 2002, Eisner 1991). The researchers seek to obtain a deep, rich and holistic view of the context (Creswell, 2003) and attempt to capture the perceptions and attitudes of their participants. Researchers often go to the site of the participants (site, home, office) to conduct the research (Strauss and Corbin 1998). The close proximity of the researchers to the participants and the field may introduce a range of personal and ethical issues and bias, which must be controlled and eliminated. This proximity was studied by (Strauss and Corbin 1998), who argued:

> *"Because of the close proximity to the data source objectivity and sensitivity during data collection and analysis must be controlled to control intrusion of bias"*. (Strauss and Corbin 1998, 42).

4.5.2.2 Data Collection Process and Approach

Due to the distinct mode of strategy of inquiry, collection of data can be by means of interviews, informal observation and reviewing of documents. Then (1996), and Seymore *et al.* (1997) advocate that qualitative research encompasses two broad categories namely the phenomenological and the ethnographic. The former relates to the interpretivism method whereby the researcher is actively involved in the data collection and analysis, in order to capture the essence of the account. Researchers in grounded theory, narrative studies and other applied studies tend to follow this line of research (Silverman, 2005). Some of the data Silverman adds, may be quantified as with census or background information about the persons or objects studied but the bulk of the data collection and analysis is interpretative. Other types of data collection involve the researchers in gathering data by means of interviews, case studies and observations, techniques. Interviews in qualitative research tend to be open-ended where the respondents are according to (Creswell, 2003) asked to "tell their story". Silverman (2005) claims that qualitative procedures stand in stark contrast to the methods of quantitative research with respect to three main areas:

1. Approach to knowledge claim.
2. Strategies of inquiry.

3. Methods of data collection, and analysis.

Creswell (2003) described this approach to data collection as:

> *"The one where the inquirer often makes knowledge claims based primarily on constructivist/Advocacy perspectives, with an intent of developing theory or pattern) or advocacy/participatory perspectives (political, issue-oriented, collaborative, or change oriented). It also uses strategy of inquiry such as, narratives, phenomenologies, ethnographies, grounded theory studies or case studies."*(Creswell 2003, 18)

The strategies of inquiries chosen in a qualitative project have a dramatic influence on the procedures. These procedures are anything but uniform. They vary from ideological perspective (Lather 1991), to Postmodern thinking (Denzin and Lincoln 2005), to Philosophical stance (Schwandt, 2000) and to systematic procedural guidance (Strauss and Corbin 1998). Many strategies exist such as the 28 approaches identified by (Tesch, 1990) as cited by (Creswell, 1998), the 19 types of Wolcott's (2001). However Creswell (1998) summarized these approaches into five traditions of inquiry which represent an encompassing focus from narrow to broad as follows:

1. Narrative.
2. Phenomenology.
3. Ethnography.
4. Case study.
5. Grounded theory.

The above strategies are covered in depth in the research literature however, only a brief description is presented here for relevance.

4.5.2.2.1 The Qualitative Narrative

A plan for a qualitative procedure according to (Creswell 2003, Stake 1995) should end with some comments about the narrative that emerges from the data analysis and using the wording from participants. Researchers tend to advance several points which might be an objective account; fieldwork experiences a chronology, a process model an extended story, an analysis by cases or across cases, or a detailed descriptive portrait (Creswell, 1998).

4.5.2.2.2 The Phenomenology Strategy of Inquiry.

The procedure involves studying a small number of subjects through extensive and prolonged engagement to develop patterns and relationships of meanings. The researcher brackets his own experience to understand those of the participants (Moustakas, 1994).

4.5.2.2.3 The Ethnography Strategy of Inquiry.

Is the process where the researchers study an intact cultural group in a natural setting over a prolonged period of time by collecting primarily observational data or learn about broad culture-sharing, behavior of individuals or groups. The research involves a detailed description of the setting or individuals, followed by analysis of the data for themes or issues (Stake 1995, Wolcott 1999).

4.5.2.2.4 Case Study.

This is where researchers explore in depth a program, an event, an activity, a process or individuals. The case(s) are bounded by time and activity. The researcher collects detailed information over a sustained period of time (Siverman 2005, Stake 2005). These case studies generally include a propositional generalization, the researcher's own summary of interpretations and claims. Stake (2005) advocate that a case study optimizes understanding by pursuing scholarly research questions. A case study is both a process of inquiry about the case and the product of that inquiry.

4.5.2.2.5 Grounded Theory.

This distinctive feature of the qualitative studies generates theories that are grounded in what the participants have said in their own words. In this approach researchers attempt to derive a general, abstract theory of a process, action or interaction grounded in the views of participants in a study. This process involves multiple stages of data collection and the refinement of categories of information (Strauss and Corbin, 1998). Two primary characteristics of this design are the constant comparison of data with emerging categories and theoretical sampling of different groups to maximize the similarities and differences of information. The qualitative data collection procedures according to (Creswell 2003, Goulding 2002) involve basic methods including conducting interviews, observations, documents review, and review of audio and visual materials.

- ***Conducting Interviews.***

The researchers conduct interviews with the research participants to elicit their perceptions and listen to their lived experience. Silverman (2005) refers to thematic interviews where the sample of the research is theoretically sampled to meet the specific needs of the study. Other procedures include conducting interviews by telephone, or focus group interviews with six to eight interviewees. The interviews involve unstructured, semi structured and generally (open-ended) questions that elicit generic opinions from the participants. Interview questionnaire can be constructed after several months of collecting field data and notes through observations and informal interviews and performing preliminary analysis of the data collected Patton (2002). Certain questions are built into the questionnaire to capture the basic belief on why people do what they do, and on field notes and to highlight the discrepancies between belief and action. (Strauss and Corbin, 1998).

- ***Making Observations***.

Researchers take field notes on the behavior and activities of individuals at the research site. The researchers record, in an unstructured or semi-structured using some prior questions that the inquirer wants to know way, activities at the research site. The researchers may also engage in varying roles from non-participants to a complete participant.

- ***Documents Review.***

The researcher may collect documentary materials and transcripts. These may be public documents, official reports, minutes of meetings or personal journals and diaries.

- ***Audio and Visual Materials***.

A final category of qualitative data consists of audio and visual material. This could take the form of photographs, images, video tapes and other object.

4.5.2.3 The Research Sample and Population

In qualitative studies, the sample of the study tends to be small in size, purposefully selected, but studied in depth and theory driven (Marshall and Rossman 2006, Strauss and Corbin 1998). This is in contrast with the quantitative studies where dealing with statistics and figures mandates the use of the large sample size (Goulding, 2002). Purposive sampling rather than random allows researchers to choose cases where the features and elements under investigation are present in the sample since research population samples are not instantly available. The

purposefully selected participants or documents are thought to help the researcher understand the research question. Sampling technique and sample size and type may also change according to the direction of the study and the outcome of the analysis, (Silverman, 2004).

4.5.2.4 Placement of Theory in Qualitative Studies

One of the main characteristics of the qualitative studies is their contribution to generating and building theories. Grounded theorists generate a theory "grounded" in views of participants and place it as a conclusion of their studies, (Strauss and Corbin 1998). For example, ethnographers employ cultural themes or "aspects of culture" as proposed by (Wolcott 1999, P 113). Qualitative studies are in which a theory becomes the end point for the study (Strauss and Corbin, 1998). It is an inductive process of building from data to broad themes to generalized model or theory (Punch 1998). The logic of this inductive approach is defined by (Creswell, 2003) is shown in **Figure 4.4.** The researcher begins by gathering detailed information from participants and forms this information into main categories or themes. These categories or themes are developed into broad patterns, compared with personal experiences or with existing literature. The development of themes and categories into patterns, theories, or generalizations suggests a varied end point.

Qualitative inquirers use theory in their studies in several ways. They employ theory as a broad explanation (Creswell, 2003). Building a theory is not the only goal of doing qualitative research. High-level description or conceptual-ordering also are equally important to the generation of knowledge. Data collection, analysis and eventual theory stand in close relationship to one another. Silverman (2005) argued that researchers do not begin a project with a preconceived theory in mind. Rather, researchers begin with an area of study and allow the theory to emerge from the data and develop into broad themes and coalesces into a grounded theory or broad interpretation**.** An unfolding research model according to (Goulding, 2002) makes it difficult to prefigure qualitative research tightly at early stages. Theory also appears as an end point of a qualitative study in the form of a generated theory, a pattern, or as a generalization that emerges inductively from data collection and analysis.

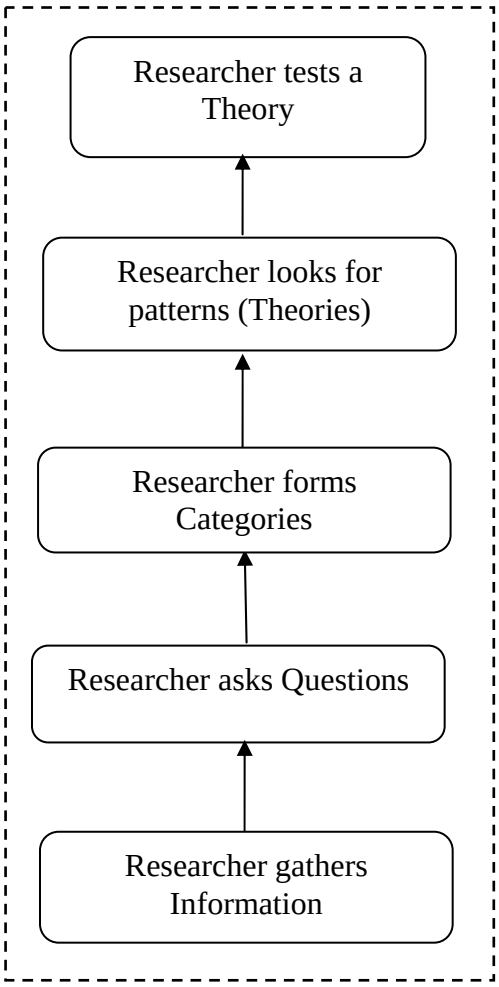


Figure 4.4. The Inductive Mode of Research in Qualitative Research.
Source: Creswell (2003)

Some qualitative studies do not include an explicit theory and present descriptive research of the central phenomenon (Goulding, 2002).

4.5.2.5 Qualitative Data Analysis

The qualitative approach as advocated by (Strauss and Corbin 1998, Krueger, 1994) distinctly features data collection and analysis running concurrently. Analysis begins with the first interview which leads to the next interview or observation, followed by more analysis, more interviews and so on. It is the analysis that drives the data collection, which creates a constant interplay between the researcher and the research act, (Denzin and Lincoln 2005). Researchers will use their knowledge and to analyze data without forcing their explanation on the data. Strauss and Corbin (1998) argue that researcher must learn to listen and let the data speak for themselves. They must

take a more flexible, less preplanned approach to research. Analysis is not structured; it is a free flowing in which the analysts move quickly back and forth between types of codes using analytic procedures freely. They add, researchers organize and prepare the data for analysis, transcribing interviews, optically scanning materials, typing up field notes, or sorting and arranging the data into different types depending on the sources of information. Patton (2002) describes the process of inductive analysis as:

> *"Discovering patterns, themes, and categories in one's data, in contrast with deductive analysis where the analytic categories are stipulated beforehand according to an existing framework".* (Patton 2002, 453)

According to (Goulding, 2002), the researcher filters the data through a personal lens that is situated in a specific socio-political and historical moment. Rossman and Rallis (1998) proposed that qualitative detailed analysis should begin with a coding process. They defined coding as:

> *"The process of organizing the materials into "Chunks" before bringing meaning to those chunks". (*Rossman and Rallis 1998, 171).

Coding process according to (Silverman 2003, Strauss and Corbin 1998) means the process of conceptualizing, reducing, elaborating and relating themes, patterns and categories. This involves generating categories of information (Open Coding), selecting one of the categories and positioning it within a theoretical model (Axial Coding) and then explicating a story from the interconnection of these categories (Selective Coding). The purpose of coding procedures during the data analysis according to (Goulding, 2002) is to lead researchers to achieve the following objectives:

1. Build rather than test a theory.
2. Provide researchers with analytic tools for handling masses of raw data.
3. Help analysts to consider alternative meanings of phenomena.
4. Be systematic and creative simultaneously
5. Identify, develop, and relate the concepts that are the building blocks of theory.

Taped interviews and participant's taped diary will be transcribed verbatim (Rossman and Rallis 1998). Morse (1994) indicated that ethnographers index or code their data using as many categories as possible. Morse (1994) described the process of data analysis as a relentless search for answers. She reported:

> *"Researchers examine and understand and interpret the data more openly. That is a process of piecing together data, of making the invisible obvious, of linking seemingly unrelated facts logically, of fitting categories one with another"* (Morse 1994, 25).

Literature as argued by (Goulding, 2002) should be used as a foundation for developing theories and generating questions and not permitted to hinder creativity if it is allowed to stand between the researcher and the data. According to (Creswell, 2003) the data that emerges are descriptive, reported in words primarily the participant's words. Rossman and Rallis (1998) suggested that analyzing data should follow the following procedure:

1. The researchers should review the data material holistically to get a feel of the broad content.
2. Look for the main themes, patterns concepts in the data. This involves taking text data or pictures, segmenting sentences into categories, and labeling those categories with a term, often based in the actual language of the participants.
3. Code the concepts descriptively, analyze and give the codes generic meanings.
4. Classify and interpret the categories that emerge, to form the foundations for developing theories.

Classifying according to (Creswell, 2003) indicates grouping concepts for similarities and differences. This approach to data analysis involves carrying out microanalysis of certain interview and tapped material. Microanalysis includes open and axial (intersecting or linking) coding. Microanalysis, involves very careful, open, minute examination and interpretation of data. Sometimes line by line analysis discovers categories, their properties, dimensions and uncovers their relationships (Creswell 2003). Carrying out microanalysis according to (Silverman, 2005) compels the analyst to listen closely to what the interviewees are saying and how they are saying it. Another form of qualitative data analysis develops analytical description by producing descriptive narrative of the findings. Bryman (2004) summarized the main distinctive features of these two research paradigms as listed in **Table 4.1.**

Table 4.1. Some Differences Between Quantitative and Qualitative Research Methodology.

	Methodology	
Method	Quantitative Research	Qualitative Research
Observation	Preliminary work, e.g. prior to framing questionnaire.	Fundamental to understanding another culture.
Textual analysis	Content analysis, i.e. counting in terms of researchers' categories.	Understanding participants' categories.
Interviews	Survey research, mainly fixed- choice questions to random samples.	Open-ended questions to small samples
Transcripts	Used infrequently to check the accuracy of interview records	Used to understand how participants organize their talk and body movements
Role	Fact-finding based on evidence or records	Attitude measurement based on opinions, views and perceptions measurement.
Relationship between researcher and subject	Distant	Close.
Scope of findings	Nomothetic.	Idiographic.
Relationship between theory/concepts and research.	Testing/confirmation.	Emergent/development.
Nature of data.	Hard and reliable	Rich and deep

Source: Bryman (2004).

4.5.3 The Mixed Method

This approach is the process of combining both quantitative and qualitative methodologies whereby the researcher uses both strategies to collect and analyze data in different order and priority. The two distinctly different methodologies are linked together in a manner that they complement and supplement each other (Teddlie and Tashakkori 2009, Bryman 2006). Combining methods is not new according to (Creswell, 2008, Bryman 2006, Cuevas *et al.* 1996). Greene, *et al.* (1989), debated the usefulness of this parallel approach of combining the two methods. They argued that a systematic approach must be considered based on implementation, priority, and theory perspective as presented and illustrated in **Table 4.2** in order to guide and validate the use of this combined method. In the mixed methods, or multi-methods as referred to by (Teddlie and Tashakkori 2009) both inductive and deductive reasoning are at work. The priorities of what data to collect

first and how to integrate two sets of the data in order to either test or generate a theory is crucial to the success of this method.

Several researchers including (Sandelowski 1995a, Atkinson and Hammersley 1995) questioned whether there is a place for this mixed method and how linking both paradigms will effectively contribute to the general knowledge. Qualitative and quantitative paradigms may be used to complement one another since both methodologies search for a better understanding of the world and attempt to demonstrate trustworthiness and neutrality of their findings (Csete and Albrecht 1994). Researchers as argued by (Silverman, 2005) must maintain the focus on the research question rather on the primacy of the method. Combining research methods and the use of triangulation as argued by (Strauss and Corbin 1998) could be an effective tool to overcome the criticism of the lack of accuracy of the findings. The choice of using both paradigms offers the researchers the benefit to broaden the acceptability of the investigation and the reliability of the findings.

Table 4.2. Decision Choices for Determining a Mixed Methods Strategy of Inquiry

<table>
<tr><th>Implementation</th><th>Priority</th><th>Integration</th><th>Theoretical perspective</th></tr>
<tr><td>No Sequence Concurrent</td><td>Equal</td><td>At Data Collection</td><td rowspan="3">Explicit</td></tr>
<tr><td rowspan="2">Sequential-Qualitative First</td><td rowspan="2">Qualitative</td><td>At Data Analysis</td></tr>
<tr><td rowspan="2">At Data Interpretation</td></tr>
<tr><td rowspan="2">Sequential-Qualitative First</td><td rowspan="2">Quantitative</td><td rowspan="2">Implicit</td></tr>
<tr><td>With Some Combination</td></tr>
</table>

Source: (Greene *et al.*1989).

When the purpose, according to (Flick, 1998), is to build a well integrated, dense, developed and comprehensive theory, the interplay of methods is necessary. The qualitative should direct the quantitative and the quantitative feedback into the qualitative in a circular interplay, but at the same time evolving, with each method contributing to the theory.

Silverman (2005) claimed that mixed method is often adopted in the mistaken hope that they will reveal the whole picture; Silverman argues:

> *"The whole picture is an illusion which speedily leads to scrappy research based on under-analyzed data and an imprecise or theoretically indigestible research problem. Some novice researchers may be tempted to move to another data set when they are having difficulties in analyzing one set of material"* (Silverman 2005, 122).

This method has limitations according to (Creswell, 2008). It requires great efforts and expertise to adequately study a phenomenon with two separate methods.

4.5.3.1 The Role of the Researcher

This form of multiple studies poses many challenges on the researchers who have to define the rationale for adopting this mixed approach and explain how the data will be collected and converged. Depending on the priority of the method selected, researchers may in the first phase choose to obtain numeric statistical results as proposed by (Creswell 2008, Teddlie and Tashakkori, 2003) and then follow up with a second phase, where through more focused qualitative interviews, detailed views of a phenomenon are discovered. Researchers who adopt this mixed method tend to spend more time in the data collection process and find themselves shifting between the two modes of the strategies of inquiry and the need to collect and analyze both quantitative and qualitative data (Locke, *et al.* 2000). This position as proposed by (Christians, 2005) is very sensitive and requires the researcher to maintain an impartial stand specifically in the case of theory building approach where deductive logic and inductive mode are working together.

4.5.3.2 Data Collection Process and Approach

In the mixed method research, researchers intentionally collect and mix the quantitative and qualitative data in a single study. In this plural approach the researcher may choose to start the study with qualitative data collection (Silverman 2005). This is done by conducting face to face, open- ended ethnographic interviews to explore, and generate themes and concepts which will be used as a theoretical lens to guide in focusing the key questions in the second stage. The first stage is then followed by a quantitative data collection, which adds precision and scientific reasoning to the softer data collected (Teddlie and Tashakkori 2009). Because of the

open approach offered by this method, data collection may be through field survey, open and closed-ended interviews, and case studies, (Goulding, 2002). The researchers, according to (Chase, 2005) must weigh up the priority and direction of the study, and define the following strategies of inquiries. This includes answering the following questions:

- Would it be best to proceed with the data collection by using a survey questionnaire to collect data quantitatively? Is it more appropriate to start the data collection with interviews, what type of interviews, how many interviews should be aimed for?
- Would it be more informative to collect both types of data concurrently and with equal priority so that one form of data would guide and assist in the interpretation of the findings from the other method? How can the validity and reliability of the analysis be guarded and substantiated?
- Where will the interviewees be found and what procedure to follow. Would triangulating the sources of data eliminate the intrusion of bias?
- What methods and techniques should be used to analyze the data?

Depending on the emphasis of the study, the desired outcome and targeted audience, the researcher will design the data collection phase and the type of data required for either testing or building a theory.

4.5.3.3 Placement of Theory in Mixed Methods Studies

Mixed method studies may include theory deductively in theory testing and verification, or inductively, as in emerging theory or pattern (Creswell 2003). The use of theory may be directed by the emphasis on either qualitative or quantitative approaches (Hausman, 2000). Mixed method researchers as advocated by (Sekaran, 1992) can make the theory explicit as a guiding framework for the study. He indicated that this framework would operate regardless of the implementation, priority and integrative features of the strategy of inquiry. The priority of the strategy of inquiry and the use of the theory, whether as an inductive or deductive framework, will eventually influence the placement of the theory.

4.5.3.4 Data Analysis

The interplay technique and crossover between qualitative and quantitative methods may be useful and allow for a margin of flexibility. However, Silverman (2005)

warns that the implications of mixing may also lead to confusion and distorted results. According to (Goulding, 2002), researchers may commence the data analysis by quantifying qualitative data initially using the coding process to identify the themes, and then count the number of times they occur in the text data. Data conversion technique using *"quantitizing and qualitizing of data"* as recommended by (Teddlie and Tashakkori 2009, Patton 2002) is used. This technique allows transforming quantitative data that can be analyzed qualitatively and the process of converting narrative qualitative data into numeric quantitative data that can be statistically analyzed. Teddlie and Tashakkori (2009) illustrate the continuum of the qualitative, mixed method and quantitative relationship shown in **Figure 4.5.**

Zone (A) consist of totally qualitative, research with its greater emphasis on constructivist, inductive logic, while zone (E) consists of totally quantitative research with numeric, postpositivist, deductive logic. Zones (B) and (D) represent some shared qualitative and quantitative components. Zone (C) represents totally integrated mixed method research. The arrow represents the qualitative-mixed method- quantitative continuum. This enables the researchers to compare quantitative results with qualitative data.

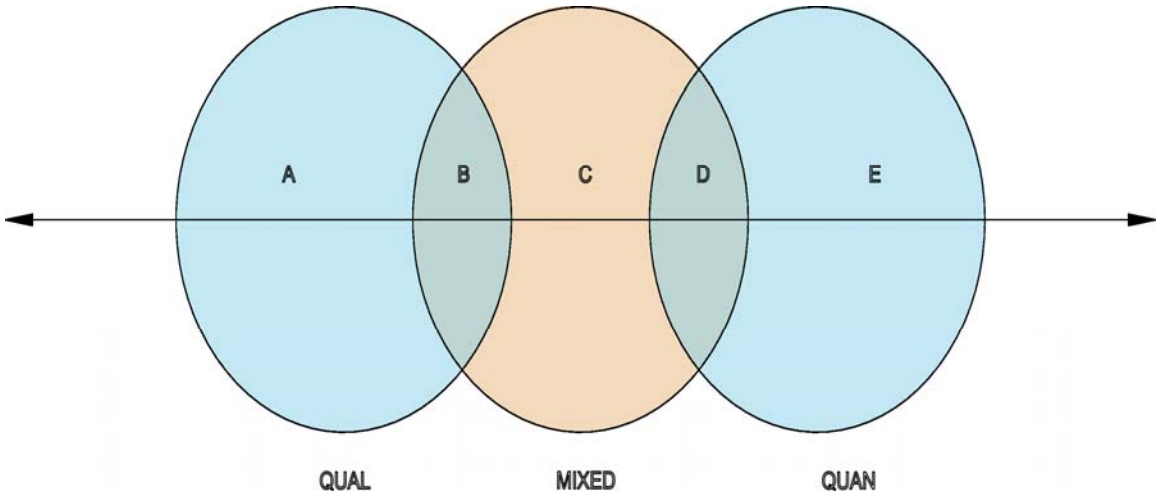


Figure 4.5. The Qualitative, Mixed Method, Quantitative Continuum.

Source: Teddlie and Tashakkori (2009)

4.6 Strength and Weakness of both Paradigms and the Selected Methodology

Discussing the strengths and weaknesses of each paradigm, including the mixed method, has provoked considerable debate amongst various industry stakeholders

and academia. However, researchers including (Creswell 2008, Freshwater 2007, Raftery *et al.* 1997) believe that each method has its inherent strength and weaknesses, and the targeted audience. According to Raftery *et al.* (1997), today, there is a much wider choice of methodologies for research that should not create a battlefield of intellectual conflict. Each research approach must be given its due recognition and valued for its unique contribution to knowledge Bryman (2008). Moreover, Strauss and Corbin (1998), Power (1996), do not believe in the primacy of either research method. They advocate that when choosing a research mode the importance and focus should be more on the problem and not the method. Creswell and Garrett (2008)**,** advocate that researchers have to understand the research question and different methods can be employed to answer this question by designing the approach to solve it. Seymour and Rooke (1995), in their study of the culture of the industry and research identified many areas of cultural differences between the rationalist and interpretive paradigms. They argue that the rationalist/positivists take for granted the interpretative frameworks that are used to organize and communicate perception, thus effectively ignoring them. Instead of investigating the interpretations of others, they simply assert their own. Further, they consider the rationalist paradigm as an obstacle to research, in the sense that they view reality as being "out there" in some measurable, definable sense. They add:

> *"The rationalists are institutionalized, self-centered and narrow minded Technocrats. Theories in construction management can be generated outside the "laboratory environment"* (Seymour and Rooke 1995, 515).

Silverman (2005) added to this debate and argued that perceptions, attitudes, and meanings can not be statistically measured. Raftery *et al.* (1997), on the other hand, disagreed with Seymour and Rooke's view of the quantitative rationalist method. They advocate that the rationalists approach research scientifically, in order to discover and generalize knowledge. They assert that the interpretive method is only viable for social research.

Proponents of the qualitative method advocate that this paradigm permits the researcher to abandon unworkable lines of enquiry and reformulate new ones that have a better fit (Creswell and Garrett 2008). "The looseness that characterizes qualitative research is one of its greatest strength. Denzin and Lincoln (2005) argue that qualitative researchers rely on inferences, insight, and logic in their analysis of the data collected and generate theories that are relevant to real life issues.

The suitability, weakness and strength of the mixed method were also debated by the academia, writers and researchers in the industry which resulted in an apparent split in opinions. Greene *et al.* (1998), Miles and Huberman (1994), indicated that the mixed method allows researchers to triangulate the data in a manner that one set of findings supports and strengthens the argument of the other. Mertens (2003) continued the discussions and advocated for the importance of deploying the theory-lens technique in mixed methods as this allows for inductive and deductive logic to work together. Creswell and Garrett (2008) added that this combined, integrated method is an active process that provides a unified understanding of the research problem. They continue:

> *"The mixed method is not just a method but a "process" that encompasses all phases of the research process". (*Creswell and Garrett 2008, 327)

Besides allowing the researchers to corroborate the findings, this mixed method has an inherent strength in initiating a new line of thinking that broadens the analysis (Howe, 2004). Kothari (1998) indicated that this method lacks a well established research framework that guides researchers. Consequently, data collection and analysis will take a much longer period of time which may eventually force researchers to short cut certain areas and overlook data important to the investigation. The issue of bias in this combined method was debated by (Wolcott 2001). According to him researchers adopting this approach tend to force the results in order to prove a subjective view. The result can be a distorted and confused outcome that can not be validated nor generalized.

Ahadzi (2004) on the other hand disagreed with Wolcott and advocated that the mixed method can help expand the scope and give it more depth. Another strong feature of this method, he added, is the inherent ability to control bias since no method is superior to the other and the data collection is more sensitive. Erzberger and Kelle (2003) reported that the outcomes of multi-methods research are not always predictable. Creswell (2003) summarized the main features of these three methods as shown in **Table 4.3.**

Table 4.3. Qualitative, Quantitative and Mixed Methods Approaches .

Tend to or Typically	**Qualitative Approached**	**Quantitative Approaches**	**Mixed Methods Approaches**
Use these philosophical assumptions. Employ these strategies of inquiry.	Constructivist/Advocacy/ Participatory knowledge claims. Phenomenology, grounded theory, ethnography, case study, and narrative.	Post- positivist knowledge claims. Surveys and experiments.	Pragmatic knowledge claims. Sequential, concurrent and transformative.
Employ these methods.	Open-ended questions, emerging approaches, test or image data.	Closed-ended questions, predetermined approaches numeric data.	Both open and closed ended questions, both emerging and predetermined approaches, and both quantitative and qualitative data and analysis.
Use these practices of research, as the researcher.	Positions himself or herself Collects participant meanings. Focuses on a single concept or phenomenon. Brings personal values into the study. Studies the context or setting of participants. Validates the accuracy of findings. Makes interpretations of the data. Creates an agenda for change or reform. Collaborates with the participants.	Tests or verifies theories or explanations. Identifies variables to study. Relates variables in questions or hypotheses. Uses standards of validity and reliability. Observes and measures information numerically. Uses unbiased approaches. Employees statistical procedures	Collects both quantitative and qualitative data. Develops a rationale for mixing integrates the data at different stages of inquiry. Presents visual pictures of procedures in the study. Employs the practices of both qualitative and quantitative research.

Source: Creswell (2003).

4.7 The Selected Methodology for This Study

Having examined the above three methodologies with respect of their suitability for satisfying the objectives of this study, comparing the methods for the data collection, analysis and reporting shown by (Creswell 2003, Strauss and Corbin 1998, Bryman and Burgess 1994), it was concluded that the appropriate methodology for this study had to be a Mixed Method employing both qualitative, inductive grounded theory

and deductive, quantitative methods into a single study. Moreover, given the exploratory nature of this study the mixed method will also present the opportunity to source, examine, interpret and analyze both qualitative and quantitative data. The decision to adopt this approach is aimed at reaching a deep understanding of an area that received insufficient previous research. The study will include for reviewing the attitudes, opinion and views of many concerned key industry stakeholders and analyze their perception of the impediments for the application of D&B contracting. Exploratory research mode is chosen because, there seem to be limited knowledge available about this topic and both quantitative and qualitative data is required to fully define the impediments to the D&B system.

The review of the literature has shown that for this particular research study using a mixed method strategy will enrich the study and provide access to rigor, solid and numeric data which can supplement the qualitative data. As Zikmund (1997) stated, researchers choose and conduct exploratory research for three reasons:

1. To diagnose a particular situation.
2. To screen alternatives.
3. To discover new ideas.

Therefore, given the nature of this research problem and the level of interaction required with the research sample population to investigate the problem, combining these two methods into a single method approach will be more effective.

Taking the recommendation of (Silverman 2005, Teddlie and Tashakkori 2003, Hausman, 2002) where direct interaction with the research population is required, the mixed method approach would have a particular explanatory power as it involves a variety of different approaches. This approach is sought to bring the strength, reliability, and give legitimacy to the study since both qualitative and quantitative data shall be collected through direct interview and examined. Within the qualitative part of this study the use of grounded theory will be selected. This approach offers insight, and provides a meaningful guide to action. The grounded theory methodology inductive approach refereed to by Goulding 2002, Strauss and Corbin 1998) will be adopted for its inherent ability to encourage emergence of new issues from the data.

Another reason for adopting mixed method approach is also due to the fact there is a gap surrounding the concept of what would make the D&B project delivery option an attractive choice for the Saudi construction industry. It was virtually impossible to

know, prior to the investigation, the problems that deter Saudi public and private sector construction industry clients and contractors from adopting D&B project delivery system. Consequently, the answers had to emerge from discussions with the selected research sample. Past studies found in the literature review which pointed to the unpopularity of D&B contracting in the Kingdom of Saudi Arabia construction industry were limited to providing procurement options selection models, and comparisons between delivery options. They have overlooked the opinions and attitudes of some of the key industry participants, such as; relevant government authorities, real-estate agencies, developers, industry manufacturers and a wider public and private clients base whose views and perceptions about D&B contracting are vital to the validity of the findings.

Building on the foundations and the outcome of these past studies and acknowledging the apparent deficiencies in the areas covered, informs us with the need to examine this area in more details. The mixed method approach with its procedures for data collection, analysis and reporting is appropriate to facilitate the understanding of this research problem.

4.8 The Structure and Application of the Research Study

The following sections describe how this mixed method strategy is structured and deployed for this research study. In the Mixed studies, (Silverman 2005, Strauss and Corbin 1998) have identified that researchers start with collecting data through observations, unobtrusive measures, focus group, interviews and questionnaires and then attempt to define or construct new meanings, theories or concepts from it. The data collection strategies are not within a specific methodology domain (Teddlie and Tashakkori 2009). The guide and structure for this research study is as shown in **Figure 4.6** with the methodology comprising five stages as follows:

1. Initial observations and information gathering.
2. Data collection through review of literature/documents/audio/video, interviews.
3. Data analysis, forming preliminary categories, concepts, codes, themes, through analysis.
4. Developing main themes, and/or formulating a theory inductively.
5. Confirming, testing the findings for reliability, and generalizability and reporting the findings.

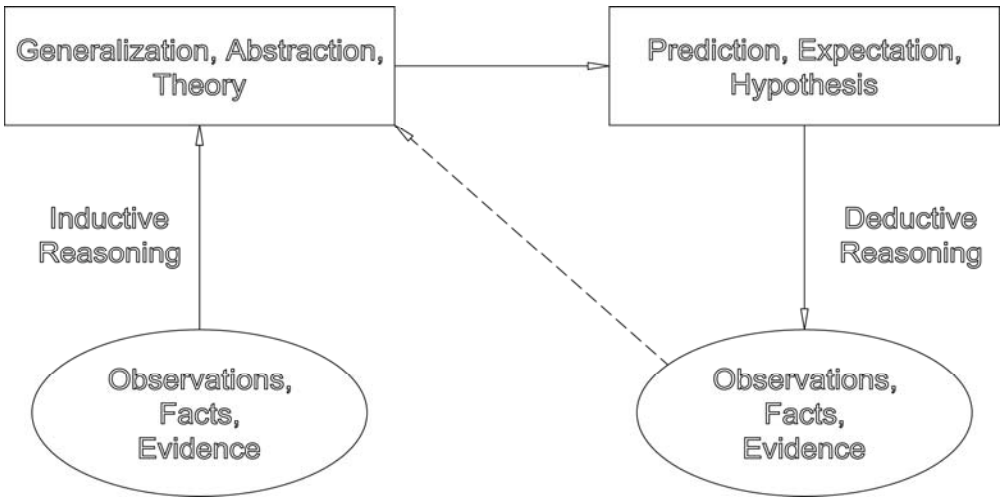


Figure 4.6. The Inductive-Deductive Research Cycle.
Source: Teddlie and Tashakkori (2009)

The following sections show the course of action taken to apply this method.

4.8.1 Stage 1. Information and Observation Gathering

The preliminary observations, interest and information collection processes about this research study problem commenced three years ago. Generic observational data was gathered from three sources.

The first was from the author's workplace where he is actively involved in directly dealing with a range of industry stakeholders including clients, contractors, suppliers, sub-consultants, insurance firms, and financial institutions where contractual decisions are made along the project lifecycle. Being a practicing consultant in a multi-disciplinary consulting firm from 1985 till 2007 and later from May 2007 till now working as a design manager for in an international contracting firm with an annual turnover in excess of $10 Billion USD. This has exposed the author not only to various industry stakeholders but also to how projects are planned, negotiated, awarded, designed, executed and delivered. These decisions covered project procurement path selection, priorities of clients' needs, how clients approach consultants and contractors and what influences their decision.

The second source of relevant information came from the growing attention demonstrated by the increased number of government and private sector sponsored seminars and conferences which had three objectives in common:

1. Draw the local industry's stakeholders' attention to the current construction boom and to use it as a platform to cope with the rising demands for

delivering much needed infrastructure, residential, educational and investment projects by using the successful examples achieved in the neighboring Gulf States.

2. Improve the method of delivering projects that are delivered to international quality standards, on time and at affordable costs.
3. Promote the partnering between the private and public sectors in delivering projects that have a national economical value like the mixed used projects in Makkah area, power generation plants for the Saudi Aramco, Oil Company in the Eastern Region and the redevelopment of Thumamah Nature park where private and public investment schemes allowed for this large entertainment project to be launched.

These conferences looked at the construction industry to reshape some of the old city centers, develop undeveloped coastal promenades, provide quality residential and mixed use, modern development on par with other cities in the region. At the heart of these conferences was the declared call for the industry at large to find new ways to deliver projects faster, cheaper and more effectively.

The third source of information was from discussing the research topic with various industry colleagues. Conflicting ideas and concepts about this research problem were debated. It was evident that many industry participants are asking for a change from the traditional project delivery system. This concern was established in the literature review by (Jaweed 2004, Al Khalil *et al.* 1999, Rukneddine 1999, Al Mansouri 1988, Al Barrack 1985) and the pertinent publications and conferences about the current unsatisfactory performance of the industry, supported the author's belief that this research problem is observed by a wide range of the industry's participants and as such, the study will receive the support needed from industry participants.

Based on the above observations, and having established the scope of the study, and in recognition of the central role that the local municipality plays in regulating the process of the design and construction at a national scale, it was decided to approach them first to get their views on this research study. Contact with planning and building officials at the local municipality in Riyadh was made. Three members of this department participated in the initial direct meeting. Discussions and description of actual industry practice took place as well as, questioning why no other project delivery systems are practiced.

These observations from the author's work place, the outcome of the discussions with the central municipality planning and building permit department and the informal discussions with industry colleagues were considered sufficient to validate the need and justify this study and determine its potential solutions. Early concepts about data sources and formal questions were beginning to be shaped.

4.8.2 Stage II. Data Collection Through Review of Literature Documents/ Audio/Video and Interviews.

Creswell and Garrett (2008), Goulding (2002), recommend that in order to obtain a holistic and broad understanding about a research problem, a multidimensional qualitative approach, using multiple interactive and humanistic methods need to be implemented for data collection. Creswell (2008), Punch (2000) advocate that quantitative numeric description of trends and attitudes developed by interpreting survey results can lead to meaningful inferences that supports narrative, and descriptive qualitative findings. Based on these recommendations data was collected from four sources as follows:

- A review of pertinent literature.
- Conducting a series of structured, semi-structured and open-ended interviews with key industry stakeholders including consulting and contracting firms, public and private sectors managers, executives, government authorities, manufacturers and real-estate financial evaluators and insurance firms. Details of these participants are presented in the following chapter.
- Examining and undertaking a case study.
- Attending a number of local and regional conferences and seminars that addressed topics related to the Saudi real estate market, Saudi construction industry, in particular, and the construction and real estate markets of the Gulf in general.

The Literature review covered a broad range of topics covering the construction and other industries. This review achieved the following objectives:

1. Examination of literature review: This review made it possible to trace the evolution of the Saudi construction industry and how it developed over the past four decades since the establishment of the National Central Planning Organization in the late sixties. The literature review was directed at past studies that examined the various aspects of the Saudi construction industry

with specific attention at D&B contraction. These topics included: procurement delivery options adopted, procurement option selection models, what influenced the clients' decisions in choosing one project delivery option over another, problems with the construction industry, delays and cost overruns, reasons for the unpopularity of D&B contracting, importance of privatization and public private partnering (PPP). The literature review helped in directing the investigation in the area where more study and information are needed and provided sources for what type of theoretical questions to ask respondents.

This part of the literature review confirmed the dominance of the traditional, project procurement delivery approach and the conflicting opinions of the various contracting and consulting firms about the adoption of D&B contracting. This review satisfied the objective of the study to trace the development of the D&B contracting and discover why it is unpopular and so attractive. The literature review also provided qualitative and quantitative data about what Saudi researchers and scholars perceive as being the reasons attributed for the unsatisfactory performance and productivity of the Saudi construction industry.

2. Another objective of the literature review was to examine what is known international and locally about D&B contracting, how it is successfully practiced within the construction industry and also in other industries such as; manufacturing, digital, and automotive. This part of the review established the premise of D&B contracting as a valid project delivery option suitable for specific applications. The review also identified the presence of other management techniques and strategies which apply this compressed time-based approach such as:
    - Lean construction,
    - Concurrent engineering
    - Design for construction
    - Design for manufacturing,

These management techniques have proven to achieve successful results in many industries including the construction industry. Many lessons and indicators were found in the other industries that can be applied in the construction industry.

3. A further objective sought in the literature review was to identify the readiness of the industry to explore new innovative project delivery options to cope with general demands for better, faster and cheaper projects.
4. A final objective of the literature review was to conduct a critical appraisal of the Saudi construction industry and to form a general understanding about the extent, scope and boundaries for the data collection and the research sample.

4.8.2.1 Collecting Data by Means of Conducting Personal Interviews

This procedure of conducting survey and interviews with participants was recommended by many writers including (Creswell 2008, Silverman 2005, Hausman 2000). This is applied when addressing both qualitative and quantitative data collection and procedures. Other procedures used were conducting interviews by telephone, and engaging in focus group interviews. Given the exploratory nature of this study it was decided to collect primary data through fieldwork to complement the secondary desk study data collection. This decision is consistent with the mixed method approach where the researchers conduct personal, direct, interviews with the selected research population. Therefore, the data was gathered by means of conducting direct interviews with selected participants that represent the full spectrum of the construction industry. Three questionnaires were as follows:

- One is aimed at the selected consulting and contracting firms. Appendix (A).
- The second is aimed at the selected seven sectors of the key industry stakeholders. Appendix (B).
- The third is part of the case study of this study which is covered in Chapter Six. Appendix (E).

These direct interviews were aimed at a range of representatives covering many areas of the industry using three types of questionnaires as explained early such as:

- Structured survey questionnaire
- Semi-structured questionnaire.
- Open-ended questionnaire.

The questions contained in Appendix (A) were organized into five broad categories as shown in **Table 4.4.**

Table 4.4. Five Categories of the Questions Asked During the Interviews.

Cat. 1	• General background information about the firm, its size, volume of work it could handle, historical data. • Professional staff/ years of experience. • Project complexity and technology used.
Cat. 2	• Knowledge with D&B and other project procurement systems. • Nature of projects that are procured along D&B contracting. • Number of projects procured along the traditional path.
Cat. 3	• Types of clients that require D&B and their level of experience with D&B. • Do consultants recommend the adoption of D&B contracting? • The stage at which D&B contracting is introduced in PLC. • Types of project procured along D&B option.
Cat. 4	• At what stage do clients approach the industry to procure D&B projects? And why do they choose the D.B.B option? • Types of problems encountered (low/ high 1 to ten). • Why clients choose the D&B project delivery option? • Level of clients' satisfaction (Cost/Time/Quality/Risk)
Cat. 5	• What are the impediments to the adoption of D&B contracting, Social, Contractual, Political, Cultural, Economical, or lack of knowledge, others? • What would make D&B option an attractive option? • Future recommendations?

These categories were to a large extent common to the consultants and contracting firms with specific modifications to suit the nature of the distinct business, approach to the market, choice of clients, and attitude towards impediments and solutions to D&B contracting.

The second questionnaire, Appendix (B) was aimed at representatives from the public and private sectors clients, real-state developers, government authorities' representative, manufacturers and suppliers, insurance firms and financial market evaluators. These participants were interviewed using thematic semi-structured and open-ended direct interviews. The participants included senior members, managers, advisors and executives at ministries, along with public and private clients, real estate developers, investors, market evaluators and insurance firms involved with the local construction industry. Details of the entire sample size and the participants representing the selected seven sectors are presented in **Table 4.5**. These additional participants from the seven sectors were either directly involved in processing projects on D&B basis, or have the experience in working within D&B environment,

as well as, the traditional option. Both semi-structured and open-ended questions were prepared within five parts which included 35 Thirty Five thematic questions as detailed below:

- The First Part, contains general information and project performance questions. This part is applicable to all sectors.
- The Second Part, includes thematic questions, specific to the Public and Private sectors, Real estate Agencies and Government Authorities sectors.
- The Third Part, includes thematic questions specific to the Manufacturing and Suppliers sectors.
- The Fourth Part, includes thematic questions specific to Insurance firms and Financial Market Evaluators sectors.
- The Fifth Part, contains Open-Ended general discussion section (Applicable to all sectors).

The survey gathered information satisfying the stated objectives. Consulting and contracting firms provided factual and realistic assessment regarding the choice of procurement options and their opinion about D&B contracting. The data collected from them was mainly important since they are the main drivers of the construction industry. The semi-structured survey with the selected seven sectors of industry stakeholders provided data regarding their views and opinion in a generic and open sense about D&B contracting and its future in the Saudi construction industry.

This combined approach for data collection achieved the following objectives:

1. Highlighted the topics that that the majority of the Saudi construction industry stakeholders consider essential when approaching the construction industry and their preference to use the traditional project delivery option.
2. Recognized the views of industry clients, designers and contractors regarding the relationships between the consultants and contractors on one hand, and the relationship between each party and the client.
3. Identified the impediments to the adoption of D&B contracting attributed to current cultural, economical, knowledge and regulatory factors.
4. The interviews assessed local knowledge about D&B contracting, how it is practiced and the willingness of various stakeholders to consider this alternative project delivery option in the present and future works.

5. Revealed the path forward that the various construction industry stakeholders highlighted to comfortably chose and implement D&B contracting.

The method of documenting the data during the interviews included taking hand written notes, recorded interviews, and tape recording were valid options. Both English and Arabic interviews were made to suit the respondents' own convenience. The timing of the interviews was left to the respondent. Sometimes, the author had to go back twice to the same respondent to complete an interview or to give the respondent time to check his notes.

4.8.2.2 Selecting the Research Sampling Method

Selecting the representative sample for this study was rather difficult as it involved a large number of professional and commercial stakeholders ranging from clients, consultants, contractors, developers, investors, suppliers, manufacturers, insurance companies and real estate evaluators. The accuracy of the sample selection will reflect on the credibility and relevance of the research. Thomson (2000), Zikmund (1997), state that there are two important criteria that the researcher must consider when selecting the sample.

First, the researcher must define what he/she want to know?

Second, about whom he/she want to know?

Creswell (2003) added that the researcher must select either a random or non random sample which best represents the research population, based on the strategy of inquiry chosen and the methodology of the research. Three additional variations to the random sampling were later added by (Silverman 2005) which include:

1. Random Probability sampling.
    a. Cluster random sampling
    b. Systematic random sampling
    c. Stratified random sampling
2. Non-random, purposive sampling or selected sampling.

4.8.2.2.1 Random sampling

This refers to the procedure of selecting respondents arbitrarily without a specific purpose regarding the sample's exact characteristics, size, type or background. However, some care must be taken in order to have a sufficient and representative number of responses reflecting a reliable percentage of the population.

1.1 Cluster sampling according to (Thomson 2000, Naoum 1998) can take two forms whereby both forms assume that many populations exhibit attributes that can be used to sub-divide them. In the One–stage cluster sampling the researcher assembles the sample from a broad list of the isolated groups and from various geographical locations and forms a consensus review of the group.

In the Two-stage cluster sampling the researcher isolates the various interest groups from the population and undertakes random sampling from each group to construct the representative sample.

This approach to probability sampling tends to be associated with the division of the population on a geographical basis where according to (Thomson 2000) the inherent geographical hierarchical structure of populations would allow them to be divided into regional population. Once this grouping is defined, random sampling would then be carried out with each cluster.

1.2 In the systematic sampling the participants are drawn from a full list of the population, however, instead of randomly selecting a member from the list, the list is systematically worked through and every "nth" member extracted and entered into the sample. This sampling approach according to (Amjad 2003, Thomson 2000) may introduce errors because it is assumed that the population membership list is not ordered.

1.3 Stratified sampling aims at ensuring that the entire characteristics of the sample population are defined first and before the sample is accurately selected to represent the entire population. Creswell (2003) argued that in stratified sampling the population is divided into a number of mutually exclusive groups, defined by a characteristic of the population such as gender or age. A random sample is then selected from each of the population groups and combined to form the sample in the same proportions as the groups are present in the entire population. This process ensures that the sample reflects the proportions and the structure of the populations it was drawn from.

4.8.2.2.2 Non-Probability Sampling

The second option for selecting the sample for the study known as the Non-random or selected sample is a chosen and purposive sample selection. This method defines and constructs the study sample from members of the population that are known to be representatives of the population. This approach relies on conducting a thorough investigation to define those members who are believed to accurately represent the population and approach them without any prior bias or predefined assumptions. Denzin and Lincoln (2005), argue that:

> *"Many qualitative researchers employ purposive, and not random, sampling methods. They seek out groups, settings and individuals where the processes being studied are most likely to occur.* (Denzin and Lincoln 2005, 370).

Given the nature of this study it was decided to select purposive sample of representative members of each sector of the construction industry stakeholder. The process of selecting the sample is explained in section 4.8.2.4 below. Purposive sampling allowed this study to choose participants where the features and elements under investigation are present in the sample selected. Moreover, the purposefully selected participants, in exploratory research as argued by (Strauss and Corbin 1998, Naoum 1998) are believed to best help the researcher understand the problem, provide the confidence that the sample can be representatives, and generalized to a broader inferences. Purposive sampling approach from the identified research population was chosen for defining the population of this research study.

4.8.2.3 Administering the Data Collecting Method

Before initiating direct interviews, it was necessary to select an appropriate method to administer this lengthy process collecting a large amount of data and to satisfy the objectives of this study. This stage included consideration for eliminating bias, sensitivity of information, reliability of analysis and validity of information gathered for generalizability. Collecting data through self-administrated direct interviews was the most appropriate method. This method presented some limitations and drawbacks including:

1. The time and cost to organize interviews especially if the sample is geographically dispersed.
2. Potential intrusion of bias since many respondents may agree to be interviewed because of their personal opinion about a specific relevant topic.

3. Not being able to control the interview session and duration as some interviewees may change the interview time, ask for more time to review his notes, and delegate the interview to another person.
4. Some incoming data may influence the subsequent interviews, changing the data collection process validation, corroboration or even focus on theoretically selected sampling.
5. Organizing, analyzing the data and reporting the findings would be a lengthy process requiring special care, skills and knowledge in content analysis since transcribing verbatim textual format and audio data can be a complex process.

On the other hand, gathering primary data through conducting direct interviews offered the following advantages over any other method for data collection:

1. The personal interviews offered the respondents the opportunity to expand and elaborate on the issues under investigation, and introduce new and fresh dimensions and insight into the research study.
2. The exploratory nature of the study diffused the need for establishing a set of questions that would preempt their potential answers. This meant that direct interviews would encourage the participants to address all aspects that they consider pertinent to the D&B contracting eliminating the potential for any predefined answers.
3. Direct interviews would avoid the problems associated with unsolicited postal questionnaires which according to (Punch 2000, Naoum 1998) exhibit a significant likelihood that potential respondent either ignore, discard or do not immediately respond to the questionnaire.
4. Direct self-administrated interviews also provided the opportunity to avoid unclear answers or "noisy data "effect or low return rate referred to by (Silverman 2005, Sekaran 1992, and Kothari 1990) to an important and broad range of topics that would be coded for analysis.

The author conducted self-administrated, direct, interviews with industry participants. Audio digital files were used because they offered detailed recorded discussions. After several rounds of modifications for testing and assessing the clarity of the questionnaires and face validity and required completion time by three scholars and peers the questionnaire was ready to be launched. The pilot format was

retested before it was finally adopted for the survey. An informational cover letter was addressed to consulting and contracting firms, managers and head of departments at the ministries, and manufacturing and suppliers companies, executive managers of the real estate developers firms, financial evaluators and insurance firms. The letter explained the purpose and reason for the survey, stated the academic purpose, the desired, the importance of the interviews, and the assurances of the strict confidence. The cover letter stated that all findings will be shared with the participants during the analysis part of the study when the investigation is complete.

4.8.2.4 Selecting the Research Population and Sample

Selecting the appropriate sample that represents a wider population was a challenge. Contacting the full list of numerous organizations and firms directly involved in the construction industry was difficult. Nonetheless, and in order to cover the full spectrum of the industry participants it was necessary to capture the views of the key participants covering the planning, engineering, manufacturing, financing and construction sectors. The sample included selected industry stakeholders as defined in **Table 4.5.** Their input is considered to be essential for this research. Each category included executives or senior members/engineers, architects, and managers of the various consulting and contracting firms, government agencies, manufacturers, suppliers and developers firms as shown in **Table 4.6.** The criteria for selecting the consulting firms, was based on selecting firms with common features related to their size, type of design and construction work, number of professional employed, turnover, capabilities, and their establishment in the construction market. These characteristics are:

- Homogenous, share broad experience and knowledge in D&B contracting.
- Involved in large and medium size projects.
- Aware of the various available project delivery methods
- Practicing for at least one decade, competing for projects.
- Engaged in a variety of projects (Residential, commercial, medical, entertainment, industrial and educational).
- Employing multi-disciplinary professionals covering all essential architectural and engineering disciplines.

Table 4.5. The Population Sample and the Percentage of Representation.

No.#	Sample Type	Number of firms/ category identified	No. of Interviews targeted	Number of firms/ category selected	No. of Interviews Agreed	No. of Interviews Made. Sample Nos.	Interviews %
1.	Consulting Firms	8	56	4	28	28	50
2.	Contracting Firms	9	63	5	35	35	55
3.	Public Sector Clients	20	20	6	15	6	30
4.	Private Sector Clients	15	15	7	10	7	46
5.	Real Estate Developers	6	6	4	6	4	66
6.	Government Authorities	4	12	4	10	8	66
7.	Manufactu-rers/ Suppliers	30	18	14	12	11	36.7
8.	Insurance Firm	3	3	2	2	2	66
9.	Financial Market Evaluators	4	3	2	2	2	66
Total		***104***	***192***	***48***	***118***	***103***	

To select these comparable consulting firms, the author consulted the bulletin for the licensed and practicing consulting and contracting firms issued by (The Riyadh Chamber of Commerce and Industry, (COCI), 2006). The selected firms were relatively equal and comparable in their size and level of experience and the volume of work handled. Nine (9) consulting firms were identified from this COCI bulletin. These consulting firms were contacted and asked whether they procure D&B projects.

Only six (6) firms answered favorably and (4) of them expressed interest to participate in this research study.

These four (4) firms were invited to this research and direct meetings with representatives from each firm was arranged.

Table 4.6 Research Population Sample Participating in the Study

Interview Position	Type of Firms	Business sector
A. Consulting Firm		
1. Head of Architecture Dept.	Multidisciplinary	Architecture (AR)
2. Senior Structural Engineer	Multidisciplinary	Structure (ST)
3. Senior Electrical Engineer	Multidisciplinary	Electrical (EL)
4. Senior Mechanical Engineer	Multidisciplinary	Mechanical (ME)
5. Senior Estimation Engineer	Multidisciplinary	Estimation (QS)
6. Senior Planning Engineer	Multidisciplinary	Planner (PL)
7. Executive Management Personnel	Multidisciplinary	Management (MR)
B. Contracting Firm		
1. Head of Architecture	General Contracting	Architecture (AR)
2. Structural Engineer	General Contracting	Structure (ST)
3. Electrical Engineer	General Contracting	Electrical (EL)
4. Mechanical Engineer	General Contracting	Mechanical (ME)
5. Estimation Engineer	General Contracting	Estimation (QS)
6. Planning Engineer	General Contracting	Planner (PL)
7. Project Management	General Contracting	Management (MR)
C. Public Sector Clients		
1. Head of Contract	Ministry of Interior	Government
2. Head of Project	Ministry of Education	Government
3. Head of Premises	Ministry of Finance	Government
D. Private Sector Clients		
1. Owner	Private	Residential
2. Owner	Private	Residential
3. Owner	Private Company	Education
4. Owner	Private Company	Commercial
5. Owner	Private Company	Commercial
6. Owner	Private Company	Entertainment
7. Owner	Private Retail	Entertainment
E. Real State Developer		
1. Deputy General Manager	Company, PLC	Projects
2. Chief Executive Officer	Company, PLC	Real State
3. Assistant General Manager	Company, PLC	Real State
4. Chief Financial Officer	Company, PLC	Real State
F. Government Authority		
1. Head of Planning	Arriyadh Development Authority	Regulatory
2. Head of Construction	Arriyadh Development Authority	Regulatory
3. Director	Riyadh Engineering Committee	Consultancy
4. Chief Planner	Riyadh Municipality	Urban Planning
5. Director / Project	Chamber of Commerce & Industries	Companies Relation

Table 4.6. Research Population Sample Participating in the Study (Cont'd)

Interview Position	Type of Firms	Business sector
G. Manufacturers / Supplier		
1. General manager	Curtain Wall	Building Industry
2. Technical Manager	Concrete Pre-cast Company	Building Industry
3. Executive Manager	Heating, Ventilation & Air-conditioning	Building Industry
4. Technical Director	Lifts (Vertical Transportation)	Building Industry
5. Director General	Building Material Products	Building Industry
6. General Manager	Riyadh Cables	Building Industry
7. Deputy General Manager	Aquarius Water Service	Water Services
8. General Manager	Ready Mix Concrete	Building Industry
9. Deputy General Manager	Metal Works (Pre-Engineering)	Building Industry
H. Insurance Firm		
1. Senior Officer	Insurance	
2. Deputy General Manager	Insurance	Medgulf Insurance
3. Costumer Relationship Manager	Insurance	Real State Project
4. Manager	Insurance	Commercial Insurance
I. Financial Market Evaluators		
1. Assistant General Manger	Financial Consultancy	Real State Advisor
2. Legal Advisor	Management Consultant	Advisor
3. Financial Consultant	Economic Business Strategy	Real State Analyst
4. Chief Financial Officer	Financial Management	Financial Advisor
5. Financial Analyst	Financial Advisor	Real State Advisor

The respective managers of these firms were issued the questionnaires forms ahead of time and were asked to distribute them randomly to the relevant individuals covering seven key disciplines that are Architecture, Structure, Mechanical and Electrical Engineering, Estimation, Planning and Project Management. Names and contact details for each respondent were forwarded to the author by designated person from each firm with set dates for each interview. Direct contact with each respondent was made to confirm and /or adjust the interview date and time as appropriate and to suit the respondents' schedule. A total of 28 Interviews were made from this category.

Similar approach taken for selecting consulting firms was taken for identifying the contracting firms. Out of twelve (12) contracting firm identified and approached only five (5) firms agreed to participate in this study.

The public sector covered the 20 ministries. Representatives of four (4) ministries agreed to participate in the study. Six (6) interviews were made with managers and executive from the premises and projects departments of the four ministries namely:

- Ministry of Interior.
- Ministry of Education.
- Ministry of Finance.
- Ministry of Health.

This list was possible because the author's firm is contracted to deliver a number of projects to these and other ministries and the selected case study for this study King Abdullah University of Science and Technology (KAUST) is one of these projects. Contact with these managers was possible and full support was extended by them.

The Private Clients Sector sample representatives selection was time consuming and certainly not straightforward, as was anticipated. The list of private clients came from the consulting and contracting firms who provided the data about their clients who regularly procure projects along D&B project delivery system. The author contacted (15) clients and asked them to participate but only seven (7) participated and the rest declined. The author targeted representation from the private sector covering sectors such as residential, commercial, entertainment, retail, leisure, etc… . However, the population sample of this category was limited to residential, commercial and retails clients only. The remaining sectors were not represented in the sample. This comment must be considered when reviewing the findings of this study.

The list of participants from the Real Estate Developers was also drawn from (The Riyadh Chamber of Commerce and Industry bulletin (2006). Six (6) real estate developers firms were actually located and approached. However, only four (4) executive managers representing four different real estate development firms were interviewed. These developers are well recognized locally and regionally. Their work included developments such as, large shopping malls, residential developments with a value exceeding $2.0 billion US dollars.

The sample for the Government Authorities included the local municipality (MOR), Saudi Standards and Organization (SASO), Arriyadh Development Authority (ADA).

The General Organization for Social Insurance (GOSI). Two (2) interviews were conducted with the (MOR). One focus group with two senior members of the local municipality planning and building permits department. Another interview was held with a senior architect from the permit department. Two hour interviews provided useful information about the past, present and future procedures of handling building permit files. Newer and faster procedures for issuing building permits and licenses adopted by the municipalities were also discussed.

These new procedures were meant to accelerate the process of obtaining a building permit and the procedures for granting a permit given the new developments in the local construction industry. One focus group (1) interview was made with representatives with the (ADA) planning and construction department. Three (3) interviews were made with the engineering department in the (GOSI) authority. Two (2) interviews were made with two engineers in the (SASO) authority. A total of eight (8) interviews covering this category were made.

The Manufacturers sample included five main trades, as shown below. The approached sample was drawn from a wide list of licensed and registered manufacturers included in the Riyadh Chamber of Commerce and Industry (2006). However, the sample was limited to firms that had the capacity to take contracts equivalent to $1,000,000+ US dollars:

1. Heating ventilation and air conditioning.
2. Electrical cables, transformers, light fittings, data and low current
3. Finishes manufacturers, covering, paint, millwork, metal works, curtain walls
4. Sanitary and kitchenware.
5. Cladding materials.

Nineteen (19) firms were identified and contacted. At least two (2) firms representing each trade were approached and invited to participate in this study.

Eventually (8) firms agreed to participate and seven (7) interviews were made with each firm representing each trade. Similarly, the list of selected suppliers firms included the following main items below. The same selection criteria that were applied to the manufacturing companies were applied to the suppliers firms. The selected firms included:

1. Reinforced concrete frames covering in situ and pre cast concrete frames
2. Water proofing materials.

3. Hardware and accessories.
4. Stone and marble.

A total of eleven (11) firms were identified and invited but only four (4) separate interviews were made with representatives from each trade of this sub-category. The manufacturers and suppliers category included a total of eleven (11) interviews.

Finding representatives for the sample of the Insurance Companies and Financial Evaluators in Riyadh was facilitated by current work relationships with two insurance firms and the author's work place. Three (3) interviews were agreed but only two (2) were conducted with senior managers representing this category.

The sample of the Financial Market Evaluators was selected from the (The Riyadh Chamber of Commerce and Industry (2006). Four (4) firms were located and contacted but only two (2) firms agreed to participate in this study. Out of three (3) interviews agreed only two (2) were actually conducted.

The final numbers of interviews planned compared to what actually conducted are illustrated in **Figure (4.7).** Data collection began in January 2007 and continued through 2007 and most of 2008. Interviews were scheduled to suite the business needs of the participants. Interviews lasted at least one hour and sometimes three hours. Some respondents asked for two sessions as they needed to check their notes. The majority of the interviews were recorded. A few of the semi-structured interviews were made over the telephone at the request of the interviewees. Focus group interviews occurred with two consulting firms and with two government authority (MOR) and (ADA), one focus group interview with one real estate development firm and one focus group with the financial market evaluators which had three analysts/engineers in attendance.

4.8.2.5 Data Gathering from a Case Study

Silverman (2005) argues that in an exploratory research mode, a case study would support an in-depth analysis of the research problem. Denzin and Lincoln (2005) also recommend examining a case study when conducting an exploratory study. Taking the recommendation of these two writers the decision led to investigating one project that was initiated using the D&B contracting. The selected case study project is The King Abdullah University of Science and Technology (KAUST), an international research institute in the Western Region of Saudi Arabia which is receiving significant media attention in the world.

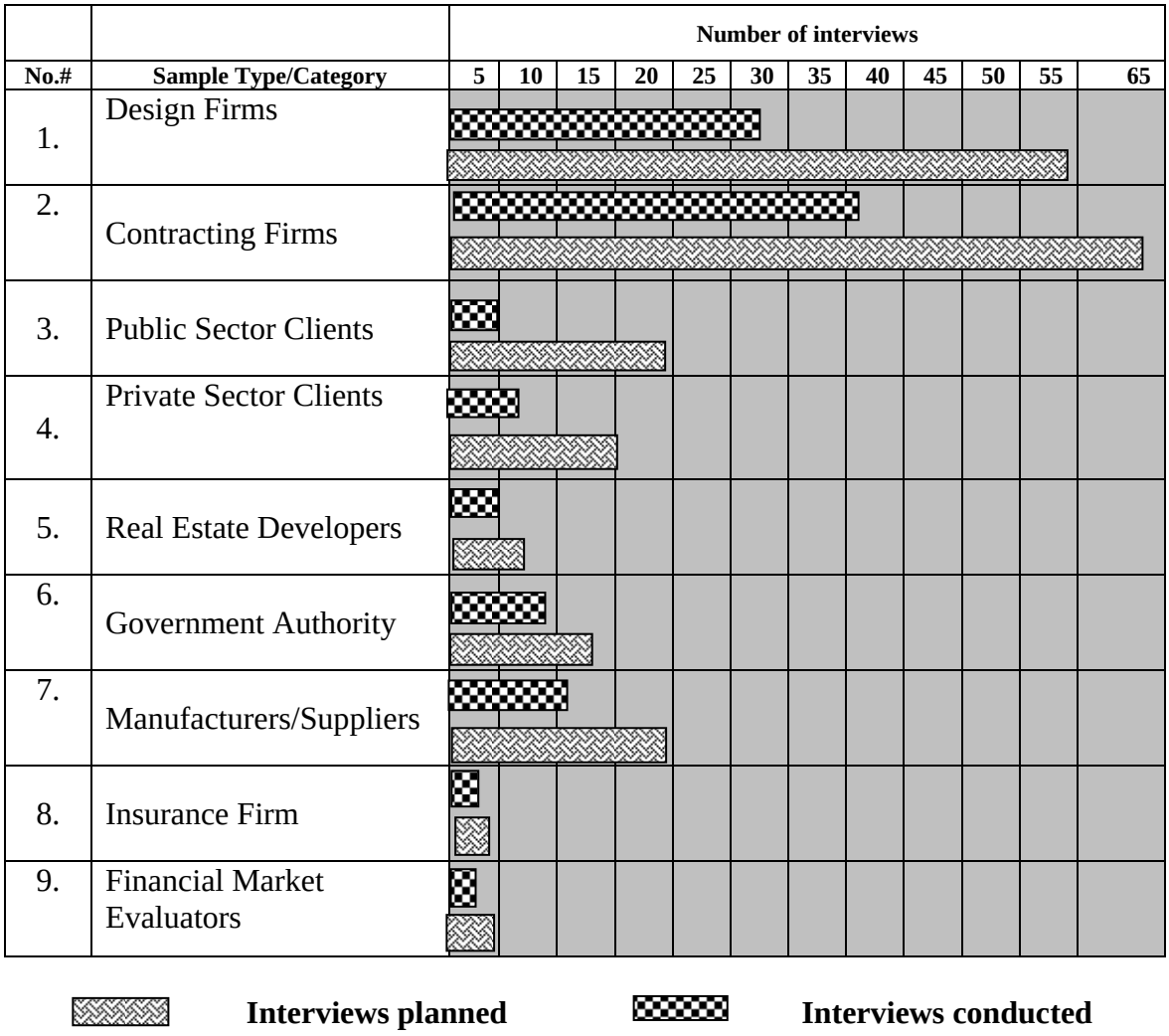


Figure 4.7. The Number of Interviews Agreed Initially and those that Were Actually Conducted.

Direct interviews were conducted with representatives from the client, consultant and the contractor involved in this research and educational university project. The investigation covered contractual, design and construction aspects of this project which was initiated in April 2006 and handed over in August 2009. Details of this case study are provided in Chapter Six. Appendix (F) provides a pictorial documentation of the construction activities.

4.8.2.6 Data Gathering From Attending and Participating in National and International Industry Conferences and Real estate Exhibitions

Additional relevant data was collected when attending and participating in several national and international construction industry events and exhibitions. The author attended construction conferences in Germany, 2008, Dubai, Egypt, Kingdom of

Bahrain, Kingdom of Saudi Arabia, and Lebanon on yearly basis between (2004 through to 2010).

These conference and events were organized by international industry institutes and government and private sector organizations including to name a few:

- Seminars about D&B sustainable design "Living Homes". (USA 2010).
- Council on Tall Buildings and Urban Habitat. (UAE,USA 2007- 2009) .
- Marcus Evans Conferences. (UAE/Germany, 2007 /2008).
- Intelligent Building Conference Middle East (Germany, 2006).
- MEED Construction Conferences (UAE, 2004-2008).
- Saudi Council of Engineers.(KSA, 2003-2008).
- Saudi National Building Code. (KSA, 2003-2009).
- The Saudi Council of Chamber of Commerce and Industry conference on the Saudi Construction Industry past and present. (KSA, 2004-2008).
- Cityscape Real estate Conference and Exhibition (UAE/KSA, 2004-2009).

These events facilitating meetings and open discussion regarding the construction industry trends, design and constructions problems, correctional measures required, areas that require research and investigation and the current trend of the industry.

4.8.3 Stage III. Data Analysis, Forming Preliminary Categories, Concepts, Codes, Themes, Through Analysis

Quantitative and qualitative data were arriving constantly for analysis. The returned and completed interviews were edited, checked for accuracy and sent to Prince Naif University in Riyadh for analysis using the SPSS software.

The author developed a form adopted from Strauss and Corbin (1998) for coding each the field open-ended interview as shown on **Figure 4.8.** Each interview was transcribed and sometimes certain data were translated from Arabic language to English. The incoming concepts and themes were continuously checked against incoming data and interviews were modified or altered as necessitated by the type of data arriving. The open-ended parts of the survey questionnaire and descriptive responses were analyzed using content analysis techniques by coding the data for main categories and themes. Conceptual ordering was implemented identifying and classifying data into discrete categories.

Interview No. Name of Interviewee Representing Date Time Start Time End Subjects covered	Remarks
Main Questions Asked-	
Main concepts /Idea	
Themes/Patterns	
Conclusions	

Figure 4.8. Field Memo Form

Source: Strauss and Corbin (1998) Modified

The data were rated according to properties and dimensions and using descriptions to elucidate these categories. This technique as argued by Strauss and Corbin (1998), allows researcher to classify data according to their various general properties and dimensions to make interpretation and distinguish among classes to examine the degree of assimilation through dimensions and properties. All ideas were explored fully and considered from different angles and perspectives. Data was further coded using the process through which data are fractured, conceptualized, and integrated to form a theory or a significant understanding. Employing the conceptual forms devised by (Strauss and Corbin 1998) shown in **figure 4.9** categories from the open-ended interviews were transcribed, analyzed and main ideas; concepts and dimensions given by the respondents were classified and noted. This stage established the process of inductively developing main themes, theories and new understandings about the research problem. Main achievements were:

- Enabled identification and coding of key concepts, giving meanings and making inferences.

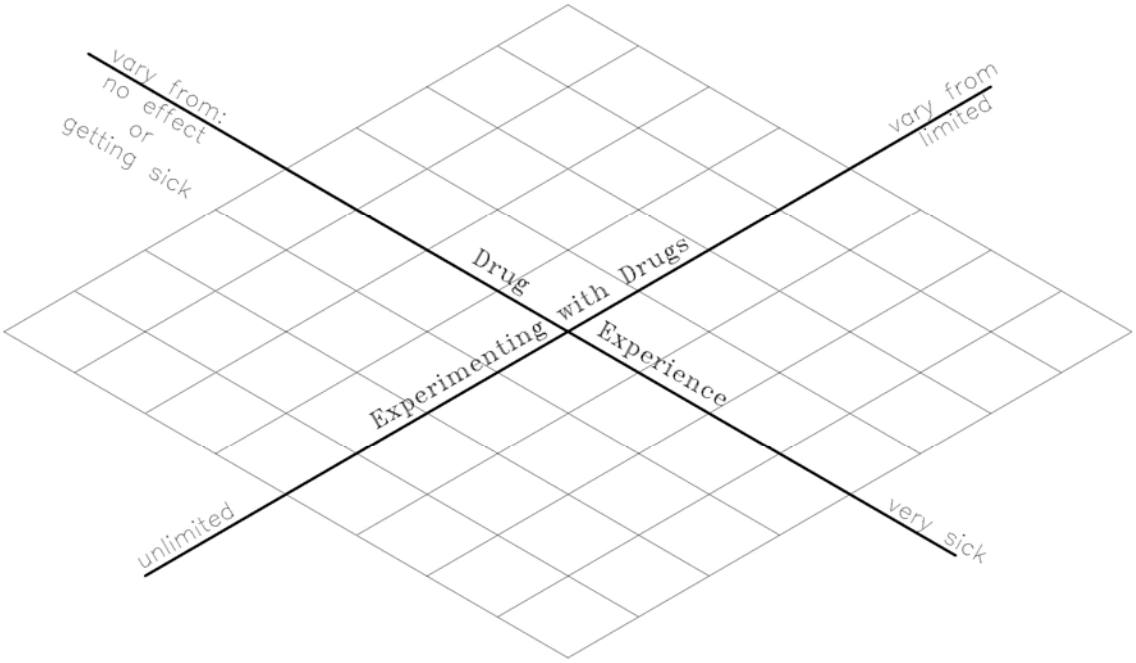


Figure 4.9. Framework Showing Cross Cut Between Two Major Concepts. The Heavy Lines Represent the Intersection of Major Categories. Light Lines Represent the Intersection of Lesser Important Categories.

Source: Strauss and Corbin (1998) With Modifications.

- Defined relationships, linkages for developing theories, patterns, concepts and categories. "Telling the story" (Marshall and Rossman, 2006).
- Offered broad holistic content and potential solutions, areas.
- Led to the emergence of the main themes.

4.8.4 Stage IV. Developing Main Themes, and/or Formulating a Theory Inductively

This stage of the methodology is an integral part of the data analysis. It was implemented to define well-developed and ordered themes to form an integrated theoretical scheme. As Hausman (2000), Denzin and Lincoln (2005), noted, the analysis involves interpretations as well as an explanation of why, when, where, what, and how events occur. By using the findings of the literature review, observations, case studies and analysis of the survey questionnaire and interviews results employing the open, axial and selective coding analytic processes the research identified main, themes, general theories, new meanings and understandings that emerged from the data analysis and interpretation.

4.8.5 Stage V. Confirming and Testing the Findings for Reliability and Generalizability and Reporting the Findings

The validity, reliability and credibility of the data collected and analyzed as argued by (Silverman, 2005, Creswell, 2008, Locke *et al.* 2000) is crucial to the findings and acceptability of any research study irrespective of the method used for conducting the study. Validity refers to the applicability and generalization of the research findings applied to other circumstances at different times and to the extent to which an account accurately represents the social phenomena to which it refers.

Denzin and Lincoln (2005) argued that it is important that researchers take measures to convince their audience that steps have been taken to ensure validity of the research findings that are reliable objective, and bias-free. The findings are all verifiable and can be tested by another researcher and the results can be applicable to another situation. Generalizability or the external validity was described by (Ahadzy, 2004) as the ability of applying results to new settings, people or samples and the ability to generalize from a sample to a broader population. Validation of findings includes internal and external validity. Internal validity according to (Ahadzy, 2004) involves the process of checking and questioning to determine whether the findings make sense and the accounts rendered are comprehensive.

Internal and external validity and testing were applied to assure sensible, accurate and easily verifiable results. This stage of the methodology was essential to confirm the findings that were generated by the data. The main concepts and themes were tested for bias, objectivity, accuracy, reliability and validity. Some interview results led the author to go back to the respondent to check and verify some results. Additional interviews occurred with multiple and different sources about a specific topic. This was evident in two incidents. The first involved legal issues that one respondent claimed to hinder the release of phased approvals from the local building and permit departments at the local municipalities.

The second case occurred when one design firm rejected D&B contracting unless the contract is led by the contractor with the designer working as a sub contractor with liability limited only to design.

In the first case, more investigation within the municipality was required to determine why phased permit approval was not happening and what needs to be changed. In the second case, two additional interviews examined various contractual and legal aspects of the problem and identified the concerns of these firms.

Control of bias intrusion was implemented with triangulation techniques as recommended by (Silverman 2005, Creswell 2003, Begley 1996, Sandelowski 1996b). These researchers proposed gathering data on the same event or phenomenon in different and multiple ways (multiple interviews and varied representatives of persons, places, events and time). The author implemented this process by sourcing different information from a wider participant's base covering a wide spectrum of the Saudi construction industry in order to obtain varied meanings and interpretations and the eventual building of the research understandings and findings. Moreover, the recommendations of (Creswell 2003, Sandelowski 1996b) were followed in validating data analysis results by discussing the initial findings with the respondents and receiving their feed back. The respondents are in the best position to comment on the findings since they have the subject knowledge. This feed back process resulted in both agreements and disagreements on the findings which led the author to consider a further focused theoretical sampling or change of course in the interim period.

Some consultants disagreed with the general trend that consultants were the main cause for not promoting the teaming with contractors. In a similar way, some public sector clients reconfirmed that the majority of the government agencies who can procure projects with D&B contracts attempt to avoid this option when the selection is based on cost and qualitative values. Making comparison to validate the results forced the author to examine data carefully to eliminate bias and be confident with the conclusions that this study has reached.

4.8.5.1 Techniques to Check for Accuracy and Control the Potential Intrusion of Bias

The intrusion of bias is a threat to validate the findings and accuracy of a study. According to (Goulding, 2002) researchers must remain distant and impartial in their data collection, as well as, the analysis and interpretation of the findings. Creswell (2003) argues that researchers must control the intrusion of bias by thinking comparatively, and by comparing incident to incident in the data.

Triangulation of data collection controls bias [Teddlie and Tashakkori 2009, Creswell 2003, Sandelowski 1996a, Begley, 1996]. These researchers proposed gathering data for the same event or phenomenon in different and multiple ways such as interviews, observations and written reports. Varying data-gathering techniques and approaches means obtaining varied meanings and interpretations of events and

actions that build these variations into theory or main observations. Creswell (2003) recommended that researchers return to the respondents, discuss findings, and obtain their feed back to establish accuracy and eliminate bias. The mixed method approach facilitated this process since both quantitative and qualitative data were sourced, compared, combined, analyzed and interpreted. This research was guided by (Creswell 2003), and recommendation and employed the techniques listed below in order to check accuracy of findings and eliminating bias:

1. Triangulation of different data sources of information was performed by examining evidence from the sources and using them to build a coherent justification for themes.
2. The use of member- checking to determine accuracy of findings was implemented. The author took the final descriptions back to participants to determine whether these participants feel that they are accurate.
3. The author used rich narratives and description to convey the findings.
4. Clarify the bias in the research. This self-reflection creates and open and honest narrative and tells the reader what to watch out for in the findings.
5. Findings whether positive or negative are presented as found counter to the themes generated. Because real life is composed of different, seldom coalescing perspectives, discussing contrary information adds to the credibility of an account and is bias sensitive.
6. The author spent prolonged time in the field interviewing and studying the KAUST case study project. Deep understanding of the phenomenon under study was developed, and the results should lend credibility to the narrative accounts.
7. The author used the peer review technique. This process involved locating a person (a peer de-briefer) who asked questions regarding study throughout the process of research.

The process adopted for validating findings in the mixed method research is considered strength according to (Creswell and Garratt, 2008). The above measures were employed to determine the accuracy of the findings, from the standpoint of the researcher, the participants, and the readers.

4.8.5.2 Reliability

Sound research must have reliability of findings. According to (Silverman 2005, Hammersley 1992) reliability refers to the degree of stability and consistency. Instances are assigned to the same category by different observers or by the same observer on different occasions**.** Punch (2000), Sekaran (1992) defined two methods for checking the reliability:

- The test-retest approach where an identical measure is tested on the same sample over two distinct periods and the reliability coefficient is obtained.
- The second method is the split-half approach where data obtained during a single survey is split into two halves and the reliability coefficient is obtained.

Every effort was made by the author to accurately and objectively report the findings as they were generated from the data. The process of collecting and analyzing the combined data employed the above techniques. These techniques were used for testing the findings to check for consistent patterns of theme development among several relevant situations. The quantitative findings from the consulting and the contracting firms were compared for agreements and disagreements with the qualitative narrative findings of the interviews results from the seven sectors of the construction industry selected participants. Results were checked and compared for consistency and/or discrepancies. In some cases, the author went back to the interviewees to confirm some findings and to in certain cases repeated the interview to establish a comforting degree of consistency and reliability in the findings.

4.8.5.3 Objectivity and Sensitivity

Sensitivity is required to perceive and recognize the connections between concepts that enable creativity and the discovery of new theory from data (Flower 2002). Objectivity, sensitivity and truthfulness are equally critical to the three research paradigms. The criteria for judging a mixed method study differ from qualitative and quantitative research. Primarily, the researchers seek believability, based on coherence, (Creswell, 2003) insight (Teddlie and Tashakkori 2009) and instrumental utility (Eisner 1991), and trustworthiness (Lincoln and Guba 1985), through a process of verification for maintaining objectivity and sensitivity during data collection and analysis to control intrusion of bias in the mixed method research. They argue that researchers must set aside their knowledge and experience to form

new interpretations about the phenomena under investigation, while retaining sensitivity to what participants say in their own words in the data. Creswell (2003), defined having sensitivity in research work as:

- Being able to see beneath the obvious to discover the new and to give meaning to the events and happenings in data. This occurs when researcher is making comparison, asking questions, and collecting more data.
- Being able to maintain a professional experience as a source of maintaining sensitivity. The researcher uses experience to compare what one thinks one sees to what one sees at the property or dimensional level without putting experience itself into the data.
- Maintaining a distance between what one sees and what the data is saying.

Similarly, (Gouldings, 2002) proposed a two-step strategy for obtaining objectivity. The first step is to maintain an attitude of skepticism. The data, hypotheses, and questions about the data arrived are regarded as provisional. These should be validated against data in subsequent interviews. The second step is to follow a research procedure of making comparison, asking questions, and sampling based on evolving theoretical concepts with rather fluid and skillful application. The above recommendations by Creswell were applied in this study. No incoming data was taken for granted until the completion of the entire list of interviews. Incoming quantitative and qualitative data was constantly checked and compared with previous data. Categorizing the data into concepts and themes and later coding the main themes generated new understandings. A distance was maintained between the data and the author's interpretation and perception. The results are impartial, independent of personal interpretation and able to be generalized.

4.8.5.4 Ethical Issues Anticipated

Ethical considerations and understandings are critical in any research study [Silverman 2005, Creswell 2003, Marshall and Rossman 1989, Merriam 1988]. Researchers must respect the rights, needs, values and desires of the informant(s) and protect critical information especially when the informant's position or institution is highly visible. The following safeguards were proposed by (Silverman 2005, Creswell 2003, Goulding 2002) to protect the informants' rights:

1. The research objectives will be articulated verbally and in writing so that they are clearly understood, including a description of how data will be used.

2. Written permission to proceed with the study as articulated will be received from the informants.
3. A research exemption form will be filed with the institutional Review Board (as applicable).
4. Informants will be informed of all the data collection devices and activities
5. Verbatim transcription and written interpretations and reports will be made available to the informants.
6. The informants rights, wishes and interests will be considered above all.
7. The final decision regarding informant anonymity will rest with the informant

According to (Creswell, 2003) deception occurs when participants understand one purpose but the researcher has a different purpose in mind. It is essential, as advocated by Creswell, to conduct a pilot project to establish trust and credibility before the study, survey or interview starts. Silverman (2005), Gouldings (2002), Punch (2000), suggested additional points to the above list that researchers must consider while collecting data and reporting findings:

- Researchers must build rapport and credibility with the individuals in the study and respect vulnerable population.
- Researchers need to develop an informed consent form for participants to sign before they engage in the research. This form acknowledges participating voluntarily and provides the right to withdraw at any time.
- Participants must have the right to ask questions, obtain a copy of the results.
- Researchers should not disturb the physical setting of site and not delay work in progress any more than is necessary.
- Researchers need to know and anticipate the possibility of harmful information being disclosed, protect the privacy of the participants, and convey this protection to all individuals involved in the study.

The above considerations were implemented by the author to maintain the secrecy and confidentiality for the respondents and the data provided. The author conducted a pilot project with a fellow colleague at the same college. The proposed list of general topics intended for the interview were studied to establish trust and respect with participants and to detect any marginalization of the participants. These ethical considerations were also noted during the data interpretation. In several cases, the author went back to the respondents to confirm results of the interviews.

4.9 Summary

This chapter established that there is no one standard research method that is applicable for every research study. The nature of the research problem, the audience targeted, objectives sought, and availability of data are factors that influence the selection of the appropriate method. The literature review showed that the construction industry uses three research paradigms namely: the quantitative; the qualitative and the mixed method which combines these two main paradigms in one single study.

Quantitative studies are objective in nature. They deductively test a theory or hypothesis composed of dependents and independents variables measured and analyzed using statistical and mathematical procedures. Researchers refer to this paradigm as the positivist because it uses scientific rationale in the search for knowledge.

Qualitative studies are exploratory; the methodological design is more inductive allowing theories and concepts to emerge during the data collection and analysis. The researchers view social phenomenon holistically and in a broad manner. Data is collected by means of direct interviews, observations, or conducting a case study.

The mixed method combines both methods in one single study. Researchers use this strategy to explore both aspects of a particular phenomenon. Two types of data are collected in different sequence, order and priority. This method is described as the one that offers researchers the best of both worlds. It is criticized for confusing the researchers and if not well controlled can lead to distorted results, takes long time to collect and analyze data which may force the analyst to take short cuts and ignore valuable findings.

This chapter has selected and justified the chosen research method which is the mixed method approach. The reasons for choosing this method were:

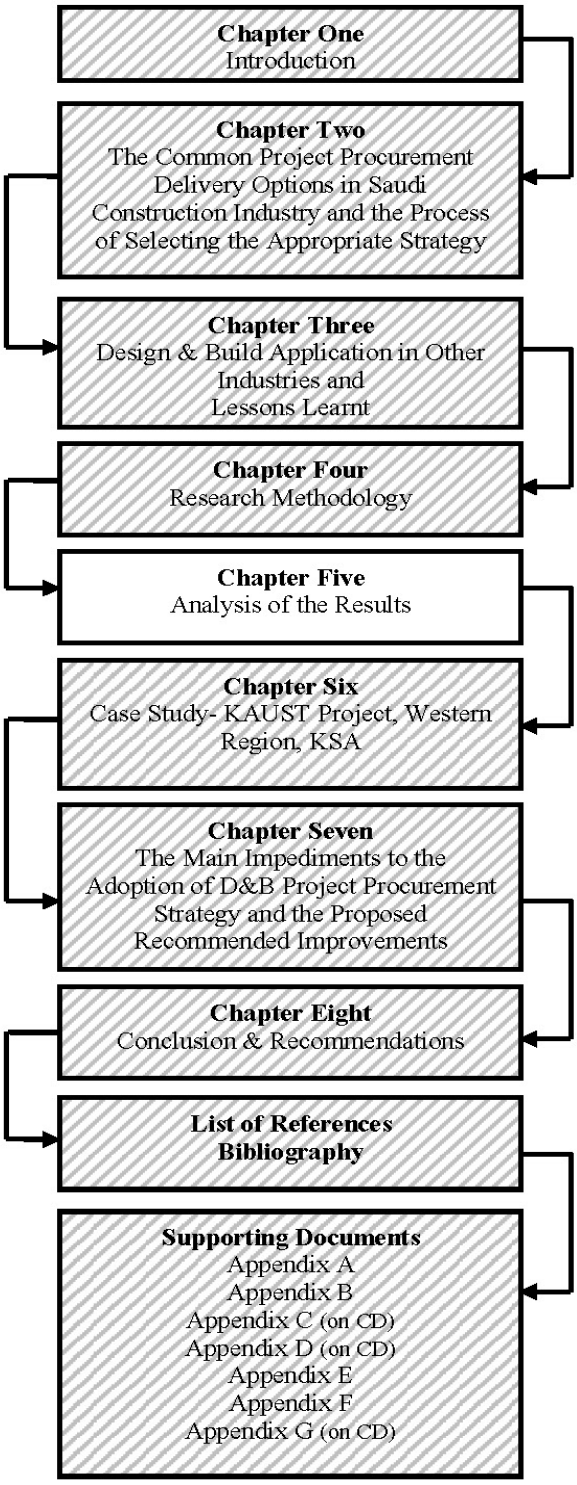
1. The flexibility offered by this method.
2. The possibility to change the research direction based on new emergent data.
3. To have access to both types of quantitative ad qualitative data.

Primary data for the study was chosen from a purposefully selected sample representing Consulting and Contracting firms, Public and Private sector clients, Developers, Real estate evaluators, Insurance firms, Government Authorities, Manufacturers and Suppliers. Direct self-administered interviews were conducted over a period of two years. Data was collected using a survey questionnaire and a

semi-structured questionnaire and conducting direct interviews. Data was also collected from a case study for a university project. This case study is presented in Chapter Six. The techniques for maintaining accuracy, and sensitivity to the data were also discussed. Data analysis and interpretation was performed by conversion technique using "*quantitizing and qualitizing of data"* as recommended by (Teddlie and Tashakkori 2009). The data collected from the two methods are mixed during the analysis into a single study. This technique allows transforming quantitative data that can be analyzed qualitatively and the process of converting narrative qualitative data. Steps for maintaining objectivity and eliminating bias from the data were discussed. Triangulation technique for obtaining multiple sources of data about a specific subject was a procedure used in this study.

The next chapters present the analysis of the survey results and the case study selected to complement this research. The King Abdullah University of Science and Technology, (KAUST), Kingdom of Saudi Arabia.

Chapter V
Analysis of the Results.



5.1 Introduction

This chapter summarizes the findings from analyzing both the direct structured, semi-structured questionnaires interviews and the open-ended questions interviews conducted with the selected sample. It explains the process and the procedures employed for editing, and interpreting the answers giving the necessary statistical and numeric computation and how the results are tabulated interpreted.

The chapter also provides the procedures for coding, classifying and defining the themes and concepts for the open-ended questions employing the integration of the statistical and thematic techniques and triangulation strategy and data conversion. Comments are recorded and the answers are interpreted and explained and where applicable, observations are presented. The data obtained from the direct interviews is also presented according to each sector of the selected sample. The structure and order of the data analysis and how this information is presented are described. **Figure 5.1.**

5.2 The Approach to Processing and Analyzing the Raw Data

The data received for analysis included a total number of 103 interviews (out of the 151 targeted) held with the selected sample. A total of sixty three (63) structured questionnaires were eventually sent to the nine (9) selected consulting and contracting firms who accepted the invitation to participate out of the seventeen (17) firms that were approached. This included twenty (28) direct interviews with representatives of four (4) consulting firms and thirty five (35) direct interviews with representatives of five (5) contracting firms. **Appendix (A)** presents the contents of the questionnaire aimed at the consulting and contracting firms. Another forty (40) direct semi-structured interviews were held with the selected seven sectors representing key local industry stakeholders. **Appendix (B)** presents the contents of the questionnaire aimed at this group. **Table 5.1** presents the details of the selected sample and the total number of interviews targeted and conducted.

The rate of the returned and completed questionnaires of the entire sample representing (68.0%) was favorable**.** Prior to the processing and analyzing the structured questions were subjected to editing. This involved careful scrutiny to avoid errors and gaps in the answers. Pre-coding of the questions was done for ease of handling and processing by the computer.

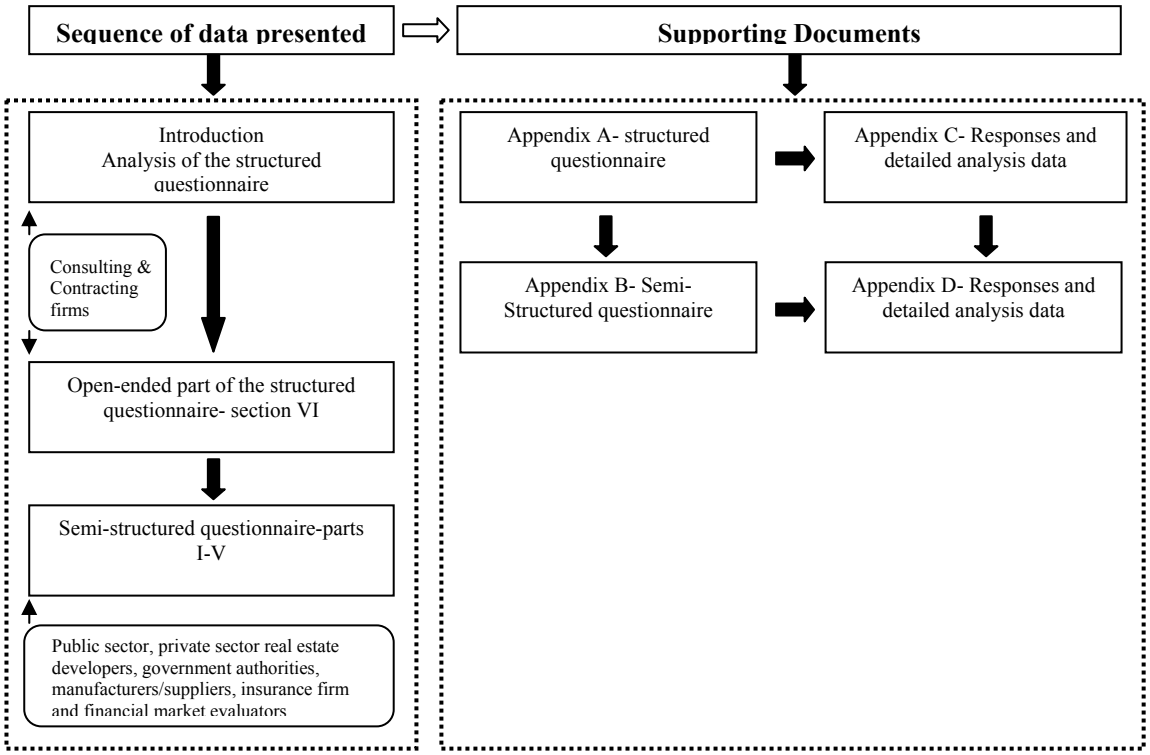


Figure 5.1. The Body of the Chapter and the Sources of Supporting Appendices.

Table 5.1. The Distribution of the Targeted and Actual Sample Size.

No.#	Sample Type	Number of firms/ category identified	Number of firms/ category selected	No. of Interviews Agreed	No. of Interviews Made. Sample Nos.	Interviews %
1.	Consulting Firms	8	4	28	28	26.4
2.	Contracting Firms	9	5	35	35	33.0
3.	Public Sector Clients	20	6	21	6	5.6
4.	Private Sector Clients	15	7	15	7	6.6
5.	Real Estate Developers	6	4	10	4	3.7
6.	Government Authorities	9	4	16	8	6.6
7.	Manufacturers Suppliers	19	14	17	11	10.7
8.	Insurance Firm	3	2	5	2	2.0
9.	Financial Market Evaluators	4	2	4	2	2.0
Total		***104***	***48***	***151***	***103***	***100***

The structured questionnaires were sent to Prince Naif University in Riyadh for analysis using the SPSS software. The analysis stage of the **Appendix (A)** structured questionnaires is presented first.

The analysis provides statistical results defining Mean values, Percentages and Tendencies, as applicable. A ranking format is used to analyze the attitudinal questions. A numerical rating is used to analyze the scoring of the respondents. The presentation of the results with interpretations follows each question. Where necessary, a presentation of descriptive analysis of the similarities and/or differences in opinions or attitudes is shown. Both supporting and conflicting results and trends are explained. The results, in certain cases, are presented in a graphical format either in tables, charts or percentages of the Mean values. These further explain the trends, attitudes, and opinions of the respondents. Descriptive frequency distribution, ranking and ratings techniques are employed to analyze the data. In many cases, the analysis provides the following answers in order to make an accurate interpretation of the analysis and to test for equality of both variances and means:

1. Descriptive Statistics Table. Giving number of participants, **(N)** or (List wise), values of minimum and maximum scores (highest and lowest) that any participants had on that variable, the **Mean value,** or average scores for each variable, and the standard deviation**.**
2. Frequencies and Percentages Tables**.** These tables provide the scores for the answers from each participant for each variable.
3. Group Statistics. Shows descriptive statistics for the two groups.
4. **T-Tests Table.** This output provides an adjustment to deal with the problem of unequal variances and as it is customary to use ***t*** test to compare two groups. ***T test*** is a good statistical test to compare one group or sample to a hypothesized mean.
5. Independent Sample Test. This test referred to as **(Levene test)** is for the assumption that the variances of the two groups are equal. If this ***F*** test is not significant, the assumption is not violated, and one uses the **Equal variance assumed**. However, if Levene's ***F*** is statistically significant (sig≤.05), then variances are statically significant and the assumption of equal variances is violated. In that case, the **Equal variances *Not* assumed**. The SPSS adjusts the ***t***, (degree of freedom) ***df,*** and **Sig. (*p*).**

6. The 95% Confidence Interval of Differences. This table is provided to show that if the test is repeated 100 times, 95 times the true (population) difference would fall within the confidence interval. If the upper and lower bounds have either the same sign (either + and + or – and -), then we know that this test indicates whether the difference is statistically significant. This means that the null finding if zero difference lies outside of the confidence interval. On the other hand, if zero difference lies between the upper and lower limits, there could be no difference.

The Mean values are predominantly used to represent and interpret voting scores of the frequencies of the answers. Low mean value indicates a high voting score since the scale of priorities is given to the respondents starting with (1). This indicates that (1) is the highest, most important and critical answer. Descending values indicate answers of lower significance. Therefore, the weight assigned for each of the criterion was based on this order. The next step taken is to collect the cumulative answers from all respondents for each variable. The highest scoring point is ranked on the top of the scale. Lower scoring criteria descend down the scale. Mean values are used consistently to represent the frequencies of the answers and the level of significance and voting level. The full detailed results of the structured questionnaires are documented and presented in **Appendix (C).**

The analysis of the semi-structured questionnaire, with selected seven sectors of the Saudi construction industry, **Appendix (B),** follows the structured questionnaire analysis**.** The author developed a form, adopted from (Strauss and Corbin 1998), shown on **Figure 4.6** for coding each of the field open-ended interviews. However, the full detailed responses and data received from this group of the seven sectors is presented in **Appendix (D).**

The large volume of raw, descriptive responses received was analyzed with content analysis techniques. Data conversion technique using "*quantitizing and qualitizing of data"* as recommended by (Teddlie and Tashakkori 2009, Miles and Huberman 1994) is also used. This technique allows transforming quantitative data that can be analyzed qualitatively and the process of converting narrative qualitative data into numeric quantitative data that can be statistically analyzed. For potential relevance, any particular observable behavior, movement or change in action or physical gesture was noted. Conceptual ordering as defined by (Strauss and Corbin 1998) was implemented identifying and classifying data into discrete categories. The data was coded according

to properties, dimensions and categories. Also, specific descriptions were used to elucidate these categories. This technique, as argued by (Silverman, 2005) allows researcher to classify data according to their various general properties and dimensions. All ideas were explored fully and considered from different angles and perspectives.

Consulting and contracting firms provided quantitative, factual and realistic assessment regarding the choice of procurement options and their opinion regarding D&B contracting. The data collected from them was mainly based of facts recognizing that they are the main drivers of the construction industry. The semi-structured questionnaires provided qualitative answers to the research questions. The combined results and analysis of both types of data are intended to provide valid inferences and conclusions that are reliable and support the external validity of the results.

5.3 The Analysis of the Data Collected

The completed structured questionnaires were targeted at both the consulting and contracting firms covering disciplines detailed in **Table 5.2**. Each question is listed, followed by a statement explaining the purpose of the question. The responses to each question are then provided, followed by comments on the responses giving interpretation from the analysis. Because of the similarity in the questionnaires for each group, one question is presented. In few incidences, two sets of questions were presented to suit the sample. One question is given to the consulting group and a modified question is issued to the contracting group. The same procedure for commenting and analyzing the answers is followed for these different questions.

Table 5.2. The Distribution and Size of the Consulting and Contracting Firms Sample.

Discipline by Group		Groups		Total
		Consulting Firms	Contracting Firms	
EL- Electrical Engineers	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
MR -Managers/Project Managers	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
ST- Structural Engineers	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
AR- Architects	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
ME- Mechanical Engineers	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
PL- Planners/Schedulers	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
QS- Quantity Surveyors /Cost Engineers	Count	4	5	9
	% of Total	6.3%	7.9%	14.3%
Total	Count	**28**	**35**	**63**
	% of Total	44.4%	55.6%	100.0%

Questionnaire Survey

Section I: General Information

Please indicate your nationality (Please tick ✓ the appropriate answer)

CONSULTANTS / CONTRACTORS

1.0 General Information

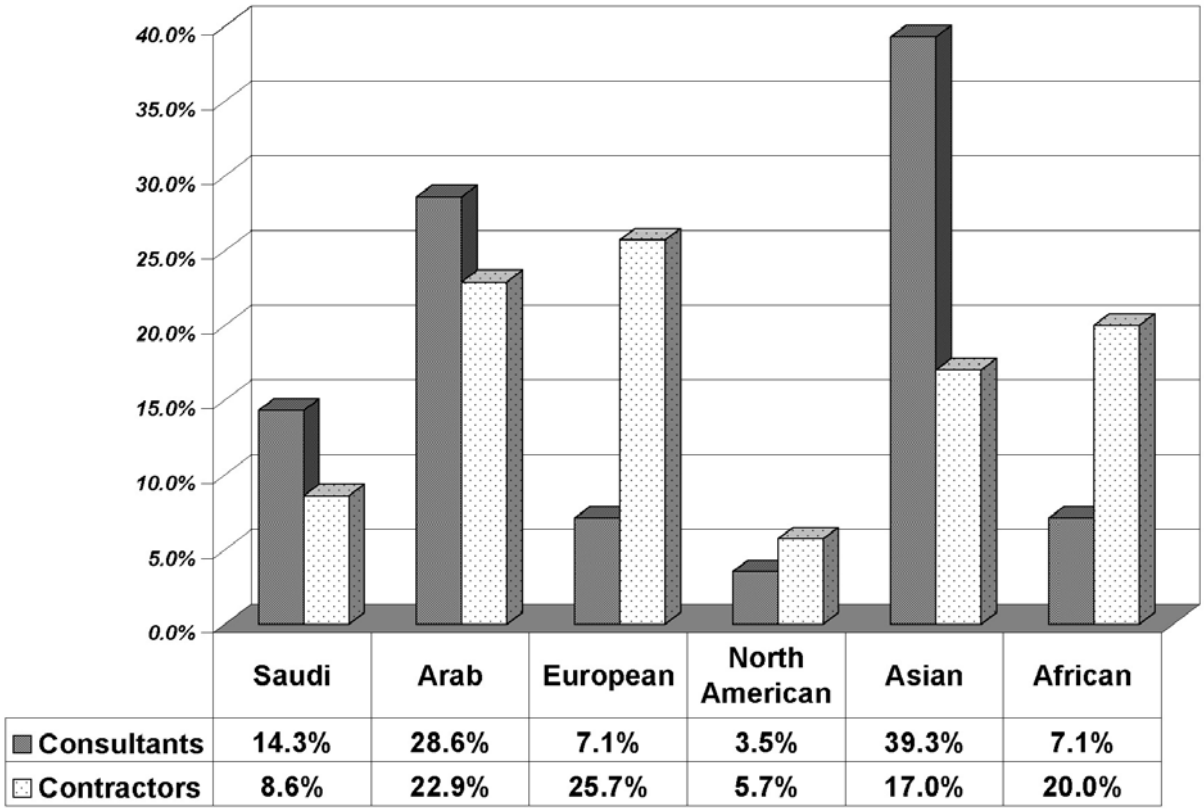
1.	2.	3.	4.	5.	6.	7.	8.
Saudi	Gulf States	Arab	European	North American	Asian	African	Others
☐	☐	☐	☐	☐	☐	☐	☐

1.1.1 Purpose

The purpose of this question is to establish the range and mix of working nationalities within each group. This question may lead to understanding the dominance of the work force within both the consulting and contracting groups. The influence of the

nationalities on the decision of these firms may be determined with respect of the choice of project delivery option.

1.1.2 Responses



	Saudi	Arab	European	North American	Asian	African
Consultants	14.3%	28.6%	7.1%	3.5%	39.3%	7.1%
Contractors	8.6%	22.9%	25.7%	5.7%	17.0%	20.0%

Figure 5.1.1. The Distribution of Nationalities within the Consulting and Contracting Sample

1.1.3 Comments

The results in **Figure 5.1.1** show the distribution of the nationalities for the entire group. The majority of the professional staff employed by the consulting firms are Asians with (39.3%) followed by Arabs with (28.6%) and Saudis (14.3%). Different results are received from the contracting firms showing a majority of professional staff being European with (25.7%) followed by Arabs with (22.9%) and then African with (20.0%). Generally, Arab professionals represent the second majority in both groups with equal relative percentages. Consulting firms have more Saudi professionals compared with contracting groups.

Section II: Consultant's Work Information (Please tick ✓ the appropriate answer)

CONSULTANTS / CONTRACTORS

2.0 What is the average number of professional staff that is present at your firm?

1.	30 – 40	2.	40 – 80	3.	80 – 120	4.	120 – 180	5.	>250
	☐		☐		☐		☐		☐

2.1.1 Purpose:

The purpose of this question is to establish a baseline of the size and qualification of each group and examine whether or not the size and number of professional staff influence their approach and capabilities to manage (D&B) Projects. The respondents were asked to report on the size of their professional staff to confirm the compatibility among the selected representative sample. The answers came as follows.

2.1.2 Responses:

By group			Groups	
			Consulting Firms	Contracting Firms
What is the average number of professional staff that are present at your firm?	120 - 180	Count	0	7
		% of Total	.0%	11.1%
	>250	Count	28	28
		% of Total	44.4%	44.4%
Total		Count	28	35
		% of Total	44.4%	55.6%

2.1.3 Comments

The results confirmed that these firms employ large number of professionals and both groups employ over 250 professionals. This results indicate that magnitude and capabilities of these firms to handle large scale projects.

CONSULTANTS / CONTRACTORS

2.2 What is the yearly average turnover that your firm normally generates in $ US Dollar (optional)?

1.	Less than 20 million	2.	25 million	3.	40 million	4.	> 50 million
	☐		☐		☐		☐

2.2.1 Purpose:

This optional question aims at finding the firm's annual turnover to see if the volume of turnover is a contributory factor that would positively or negatively influence the firm's decision to consider embarking into Design and Build process. Turnover could be an indicator of the level of risk that a firm may consider when facing a new challenges. This question is important to test the homogeneity of the representative sample.

2.2.2 Responses:

(Optional) By group			Groups	
			Consulting Firms	Contracting Firms
What is the yearly average	40 million	Count	6	6
turnover that your firm		% of Total	21.4%	17%
normally generates in $ US	> 50 million	Count	22	29
Dollar (optional)?		% of Total	78.6%	83%
Total		Count	28	35
		% of Total	100%	100%

2.2.3 Comments

The answers confirm that large firms employing a significant number of professionals are in the higher income bracket. The majority of the consulting firms (78.5%) generate over $50 million US dollars. Similarly the majority of the contracting firms (82.9%) generate over $50 million US dollars. These firms target large projects in order to remain in business. The answers given here were approximated since some respondents did not give exact figures, but approximations.

CONSULTANTS / CONTRACTORS

2.3 What is the number of medium to large size projects that your firm is awarded per annum; along the traditional project delivery system?

1. Medium size project = $ 20-50 million Construction cost 0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐

2. Large size project = $ 100-200 million Construction cost 0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐

3. Very Large size project = $ 210-500 million Construction cost 0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐

4. Mega project > $ 500 million Construction cost 0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐

2.3.1 Purpose:

The purpose of this question is to determine the size and number of design projects that these firms are awarded along the traditional path per annum. This question will highlight the importance of project size that the research sample handles, and its influence of the same on the general performance of the firms. This question will also expose the firms' response to accepting large projects along the traditional path with specific construction cost and complexity. The answers to this question will be compared with the answers to question 3.3 which presents the same question but in relation to D&B projects. It is believed that complex projects normally cost more to complete and require skilled and experienced firms. This is regardless of the project delivery option selected.

2.3.2 Responses

			Groups	
			Consulting Firms	Contracting Firms
Medium size project = $	3	Count	2	4
20 - 50 million		% of Total	7.1%	11.4%
construction cost	4	Count	2	4
		% of Total	7.1%	11.4%
	or more	Count	24	27
		% of Total	85.7%	77.1%
Total		Count	28	35
		% of Total	100.0%	100.0%

			Groups	
			Consulting Firms	Contracting Firms
Large size project = $ 100 -	1	Count	2	3
200 million construction cost		% of Total	7.1%	8.6%
	2	Count	7	3
		% of Total	25.0%	8.6%
	3	Count	13	17
		% of Total	46.4%	48.6%
	4	Count	6	12
		% of Total	21.4%	34.3%
Total		Count	28	35
		% of Total	100.0%	100.0%

			Groups	
			Consulting Firms	Contracting Firms
Very Large size project =	0	Count	1	3
$ 210 - 500 million		% of Total	3.6%	8.6%
construction cost	1	Count	11	10
		% of Total	39.3%	28.6%
	2	Count	12	10
		% of Total	42.9%	28.6%
	3	Count	3	11
		% of Total	10.7%	31.4%
	4	Count	1	1
		% of Total	3.6%	2.9%
Total		Count	28	35
		% of Total	100.0%	100.0%

			Groups	
			Consulting Firms	Contracting Firms
Mega project > $ 500	0	Count	9	14
million construction cost		% of Total	32.1%	40.0%
	1	Count	15	17
		% of Total	53.6%	48.6%
	2	Count	3	3
		% of Total	10.7%	8.6%
	4	Count	1	1
		% of Total	3.6%	2.9%
Total		Count	28	35
		% of Total	100.0%	100.0%

2.3.3 Comments

Comparable results were given by each group without any significant variation. For the medium and large size projects, contracting firms were more involved with these projects compared with the consulting group. Whereas, the results indicate that in the large and mega size projects categories, the contracting group shows slightly more involvement and interest. These results indicate that under the traditional delivery option, consulting and contracting firms are working within the general trend of the industry. There appears to be no preference for either group to be less concerned with this project delivery option. The findings support the assumption that large multidisciplinary firms who also employ large workforce mainly target large projects.

Section III: Knowledge and Awareness of Design and Build Option (Please tick ✓ the appropriate answer)

CONSULTANTS / CONTRACTORS

3.0 Are you aware about Design and Build (D&B) contracting?

1. Well Aware	2. Aware	3. Vaguely Aware	4. Not Aware
☐	☐	☐	☐

3.1.1 Purpose:

This attitudinal question is related to defining the actual understanding, awareness and knowledge of the consulting and contracting firms and their clients towards D&B project delivery option.

3.1.2 Responses

			Groups	
			Consulting Firm	Contracting Firms
Are you aware about	Well Aware	Count	11	9
Design and Build		% of Total	39.3%	25.7%
contracting?	Aware	Count	13	14
		% of Total	46.4%	40.0%
	Vaguely Aware	Count	4	12
		% of Total	14.3%	34.3%
Total		Count	28	35
		% of Total	100%	100%

3.1.3 Comments:

The responses clearly show that these selected consulting and contracting firms are generally aware of this project delivery option with a combined majority of (86%) compared with (48%) for those who are vaguely aware of the D&B option. On a closer look, contracting firms appear to be less aware about D&B option than the consulting firms with (34%) answering vaguely aware of D&B option. This answer came as a surprise and different to what some of the Saudi researchers including (Rukneddine 1999, and Al Mansouri 1988) have indicated that contractors prefer the D&B option for reasons of speed and higher profit.

CONSULTANTS / CONTRACTORS

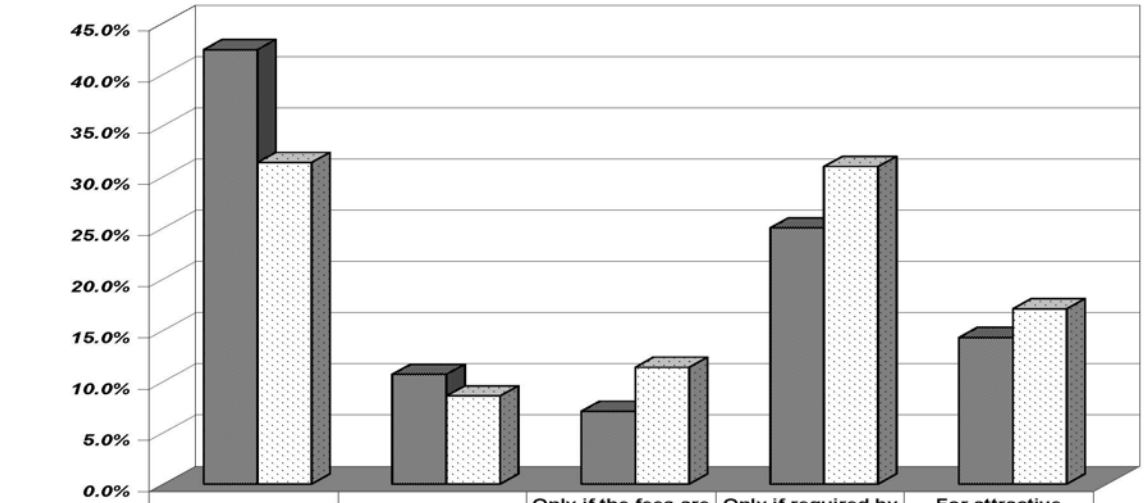
3.2 Does your firm provide Design and Build project delivery options to your Client? If the answer is no please go to section IV question 4.3

1. ☐ Yes
2. ☐ No
3. ☐ Only if the fees are sufficient
4. ☐ Only if required by repeated Clients
5. ☐ For attractive projects
6. ☐ Other (please specify below)

3.2.1 Purpose

This question is aimed at establishing the readiness of consulting and contracting firms to be involved with D&B option. This question directs the respondents that do not provide D&B services to another set of questions. This question, however, is intended to provide answers about when, why and for whom do these firms provide D&B project delivery services. The answers will help define the circumstances that influence the decisions of these key industry participants to consider responding to D&B project delivery invitations.

3.2.2 Response:



	Yes	No	Only if the fees are sufficient	Only if required by repeated clients	For attractive projects
Consultants	42.4%	10.7%	7.1%	25.0%	14.3%
Contractors	31.4%	8.6%	11.4%	31.0%	17.1%

Figure 5.3.2. The answers from the two groups that provide Design and Build project delivery options to their Clients.

3.2.3 Comments

The results show significant similarities between both groups since both groups provide D&B services with a combined majority (74.1%) compared to (19.3%) who strictly do not. The importance of repeat clients is clear in the results and both groups would provide D&B services to repeated clients with a second combined majority of (56.0%). Attractive projects received the third level of importance with a combined majority of (31.4 %) These answers show that the type of client and project is more important to the sample than the fees. In reviewing the results, there appears to be a split and a noticeable difference in views, as to whether these firms are eager to embark on this project delivery option to gain a competitive edge, or remain with less risks exposure as seen in the combined conditional responses which represent a clear majority.

CONSULTANTS / CONTRACTORS

3.3 What is the number of medium to large size Design and Build projects that your firm is generally awarded per annum?

1. Medium size project	=	$ 20-50 million Construction cost	0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐
2. Large size project	=	$ 100-200 million Construction cost	0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐
3. Very Large size project	=	$ 210-500 million Construction cost	0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐
4. Mega project	>	$ 500 million Construction cost	0 1 2 3 4 or more ☐ ☐ ☐ ☐ ☐ ☐

3.3.1 Purpose:

Similar to question 2.3, the purpose of this question was to inquire about the size and number of the D&B projects that the sample firms are awarded or involved with per year. The answers will highlight the importance of the D&B project size, and their numbers that would be of an interest to the research sample compared with the traditional D.B.B projects.

3.3.2 Responses:

			Groups	
			Consulting Firms	Contracting Firms
Medium size project = $ 20 - 50 million construction cost	2	Count	5	4
		% of Total	17.9%	11.4%
	3	Count	13	23
		% of Total	46.4%	65.7%
	4	Count	5	7
		% of Total	17.9%	20.0%
	or more	Count	5	1
		% of Total	17.9%	2.9%
Total		Count	28	35
		% of Total	100.0%	100.0%

			Groups	
			Consulting Firms	Contracting Firms
Large size project = $ 100 - 200 million construction cost	1	Count	12	14
		% of Total	42.8%	40.0%
	2	Count	11	19
		% of Total	39.3%	54.3%
	3	Count	3	1
		% of Total	4.8%	2.9%
	4	Count	2	1
		% of Total	10.7%	2.9%
Total		Count	28	35
		% of Total	100.0%	100.0%

			Groups		
			Consulting Firms	Contracting Firms	Total
Very Large size project = $ 210 - 500 million construction cost	0	Count	4	8	13
		% of Total	14.3%	22.9%	22.2 %
	1	Count	21	23	44
		% of Total	75.0%	65.7%	73.0 %
	2	Count	1	1	2
		% of Total	1.6%	2.9%	1.6%
	3	Count	1	1	2
		% of Total	3.6%	2.9%	1.6%
	4	Count	1	2	2
		% of Total	3.6%	5.7%	1.6%
Total		Count	28	35	63

			Groups		
			Consulting Firms	Contracting Firms	Total
Very Large size project = $ 210 - 500 million construction cost	0	Count	4	8	13
		% of Total	14.3%	22.9%	22.2 %
	1	Count	21	23	44
		% of Total	75.0%	65.7%	73.0 %
	2	Count	1	1	2
		% of Total	1.6%	2.9%	1.6%
	3	Count	1	1	2
		% of Total	3.6%	2.9%	1.6%
	4	Count	1	2	2
		% of Total	3.6%	5.7%	1.6%
Total		Count	28	35	63
		% of Total	100.0%	100.0%	100.0 %

			Groups	
			Consulting Firms	Contracting Firms
Mega project > $ 500 million construction cost	0	Count	17	28
		% of Total	60.7%	80.0%
	1	Count	11	7
		% of Total	39.3%	20.0%
Total		Count	28	35
		% of Total	100.0%	100.0%

3.3.3 Comments

Comparative results are given here for each of the four costs categories. In the medium and large size projects, both groups are involved with almost the same number of projects along the various scales of project values. In the large and mega size projects cost categories, the consulting firms show slightly more involvement and a larger share of the D&B projects. These results indicate that under both, the traditional project delivery and the D&B options, consulting and contracting firms are working within the general trend of the industry with almost equal interest and involvement.

CONSULTANTS / CONTRACTORS

3.4 Please specify since when has your firm been involved and working with Design and Build project delivery option?

1.	2.	3.	4.
Less than 5 years ☐	**5 - 10 years** ☐	**10 – 15 years** ☐	**Over 15 years** ☐

3.4.1 Purpose:

This question is directed at the participants to establish their knowledge and experience with the D&B project procurement option. The objective here is to define the level of accumulated experience of both groups in procuring D&B option and examine their practical experience with this option over the past two to three decades.

3.4.2 Response

By group			Groups		Total
			Consulting Firms	Contracting Firms	
Please specify since when has your firm been designing projects along Design and Build?	Less than 5 years	Count	0	1	1
		% of Total	.0%	1.6%	1.6%
	5 - 10 years	Count	1	4	5
		% of Total	1.6%	6.3%	7.9%
	10 - 15 years	Count	12	19	31
		% of Total	19.0%	30.2%	49.2%
	Over 15 years	Count	15	11	26
		% of Total	23.8%	17.5%	41.3%
Total		Count	28	35	63
		% of Total	44.4%	55.6%	100.0%

3.4.3 Comments:

Taken as a one group, the answers clearly show that the sample is well knowledgeable with the D&B option. Over forty nine percent (49.2%) combined majority states that they have been working with the D&B option for more than 10 years. Whereas, forty one percent (41%) of the total sample population is practicing D&B option for more that 15 years. The results do not share a significant difference between consulting and contracting firms as far as, embarking and working with D&B projects. The results prove that D&B option is being practiced in the Saudi construction industry by both

consulting and contracting firms alike, and for a period over two decades. These results are consistent with the literature review indicating when the Saudi construction industry was going through construction booms during the late 1980's and from the beginning of 2002 until now.

3.5 What are the types of projects that you know are being procured along Design and Build option? Please rank the frequency of each, in a priority order.

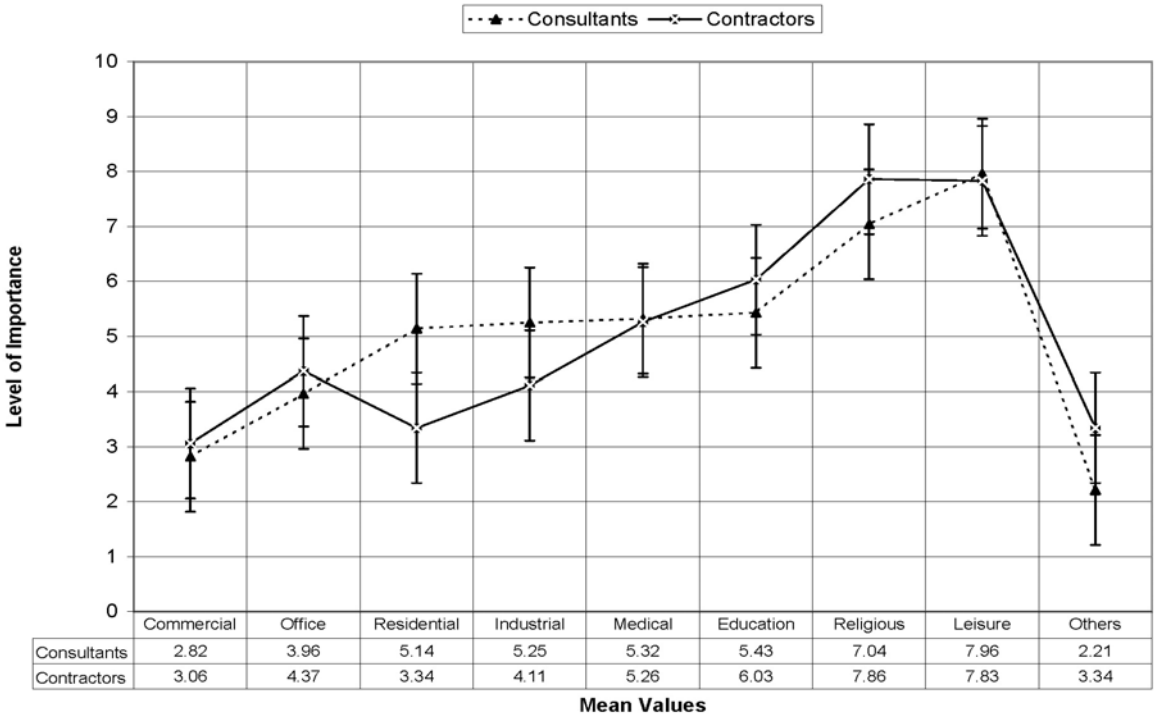
CONSULTANTS / CONTRACTORS *High* ⟷ *Low*

1. Commercial	1	2	3	4	5	6	7	8	9
2. Residential	1	2	3	4	5	6	7	8	9
3. Office	1	2	3	4	5	6	7	8	9
4. Education	1	2	3	4	5	6	7	8	9
5. Medical	1	2	3	4	5	6	7	8	9
6. Leisure	1	2	3	4	5	6	7	8	9
7. Religious	1	2	3	4	5	6	7	8	9
8. Industrial	1	2	3	4	5	6	7	8	9
9. Other, Institutional Military Aviation, (please specify)	1	2	3	4	5	6	7	8	9

3.5.1 Purpose

This question is aimed at defining which sector of the construction industry is being considered for D&B option. It will guide the research into establishing the relationships between sectors of the construction industry that are favored to be procured with a D&B and also identify the basis for considering some projects for D&B procurement.

3.5.2 Responses



	Commercial	Office	Residential	Industrial	Medical	Education	Religious	Leisure	Others
Consultants	2.82	3.96	5.14	5.25	5.32	5.43	7.04	7.96	2.21
Contractors	3.06	4.37	3.34	4.11	5.26	6.03	7.86	7.83	3.34

Figure 5.3.5. The Types of Projects that the Groups Reported as being Procured Along the Design and Build Project Delivery Option.

3.5.3 Comments:

The output tables show minimum and maximum scores that any participant had on the variables and also provide the Mean or average score for each variable. The results as shown in **Figure 5.3.5** show that consultants are working on different types/sectors of D&B projects than contractors. They are mainly involved in procuring institutional, aviation and military D&B projects. This sector scored the first ranking with a Mean value of (2.21). Commercial sector ranked second with a Mean value of (2.82). Offices and residential projects ranked third and fourth respectively. However, the contractors' involvement with D&B projects shows different priority. Commercial sector was first priority with a Mean value of (3.06). Residential sector came second with a Mean of (3.34). Both groups are in agreement when it comes to the Industrial, Medical, Educational Religious and Leisure sectors. The ***t*** test analysis was conducted to compare these results to a hypothesized population **Mean**. The author accepted **(sig≤.05)** as margin for assumptions violation. of discrepancy. The ***t*** test results show that for the Residential (0.003) and Religious (0.039) sectors, the ***t*** is statistically significant. Based on this we can say that these two results sectors have variances.

CONSULTANTS / CONTRACTORS

3.6 What are the backgrounds of your clients that request projects be procured along the Design and Build option? Please rank in priority order which client asks for D&B project.

High ← → *Low*

1. Investors	1	2	3	4	5	6	7
2. Private client	1	2	3	4	5	6	7
3. Government	1	2	3	4	5	6	7
4. Semi Government	1	2	3	4	5	6	7
5. Developers	1	2	3	4	5	6	7
6. Consultants	1	2	3	4	5	6	7
7. Others, (please specify below)	1	2	3	4	5	6	7

3.6.1 Purpose

This question is to support the classifications of the clients/sector (Question 3.5). It discovers if these two questions are in fact interrelated. This relationship is intended to provide answers with respect to the types of clients who are interested in D&B option and their background.

3.6.2 Response

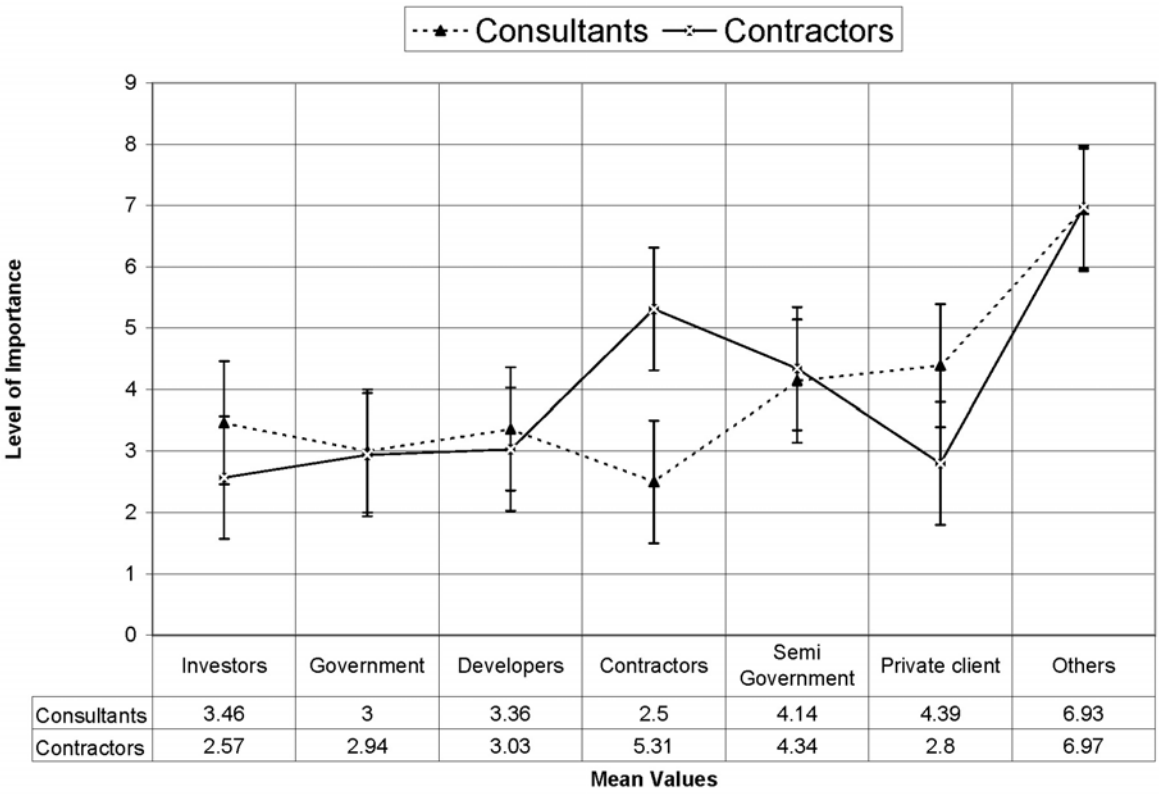


Figure 5.3.6 The Results from the Two Groups on the Backgrounds of the Clients that Request Projects be Procured on Design and Build Basis.

3.6.3 Comments:

Significantly different results were received from each group as shown in **Figure 5.3.6**. For consulting firms, contractors serve as their main clients who approach them for procuring D&B projects. This was the highest ranking score with a Mean value of (2.50). Governmental client came second with a Mean value of (3.00). Developers came third with a Mean value of (3.36). The contractors however, selected Investors as the first highest ranking score with a Mean of (2.57). Private clients came second with a Mean of (2.8). The Government came third with a Mean value of (2.94). These answers indicate that the government is promoting the use of D&B project delivery option. The ***t*** test analysis was conducted to compare these results to a hypothesized population Mean. Three results had **(sig≤.05)** margin for assumptions violation. The ***t*** test results show that the Investors sector has (0.007) variation and Private Clients sector had (0.000) and Contractors sectors showed (0.000). These three results show a statistical difference and can not be generalized. Answers from both groups however, meet at semi Government with Means at (3.00) for consultants and (2.94) and within close range with Developers with Means at (0.36) and (3.03) respectively.

Section IV: The Local Operating Environment and Objectives of Design and Build Projects (Please tick ✓ the appropriate answer)

CONSULTANTS / CONTRACTORS

4.1 At what stage of the project life cycle process do your clients generally invite you to Design and Build projects? Please rank in a priority order.

	High ← → *Low*					
1. Following the preparation of (RFP) stage	1	2	3	4	5	6
2. After the marketing / feasibility study	1	2	3	4	5	6
3.After the prequalification stage	1	2	3	4	5	6
4.After the preliminary design stage	1	2	3	4	5	6
5. After design development stage	1	2	3	4	5	6
6. Other, (please specify)	1	2	3	4	5	6

4.1.1 Purpose

This is a critical question that determines the stage of the project life cycle when clients approach the construction industry for procuring D&B projects. The purpose of this question is to determine consistency and understanding of the clients with respect to how to procure their D&B projects. It is expected that this question would provide answers regarding a clients' perception of the importance of involving consultant and/or contractors at the early prequalification stage and if the two- stage prequalification selection process recommended in the literature review is actually followed through the D&B process.

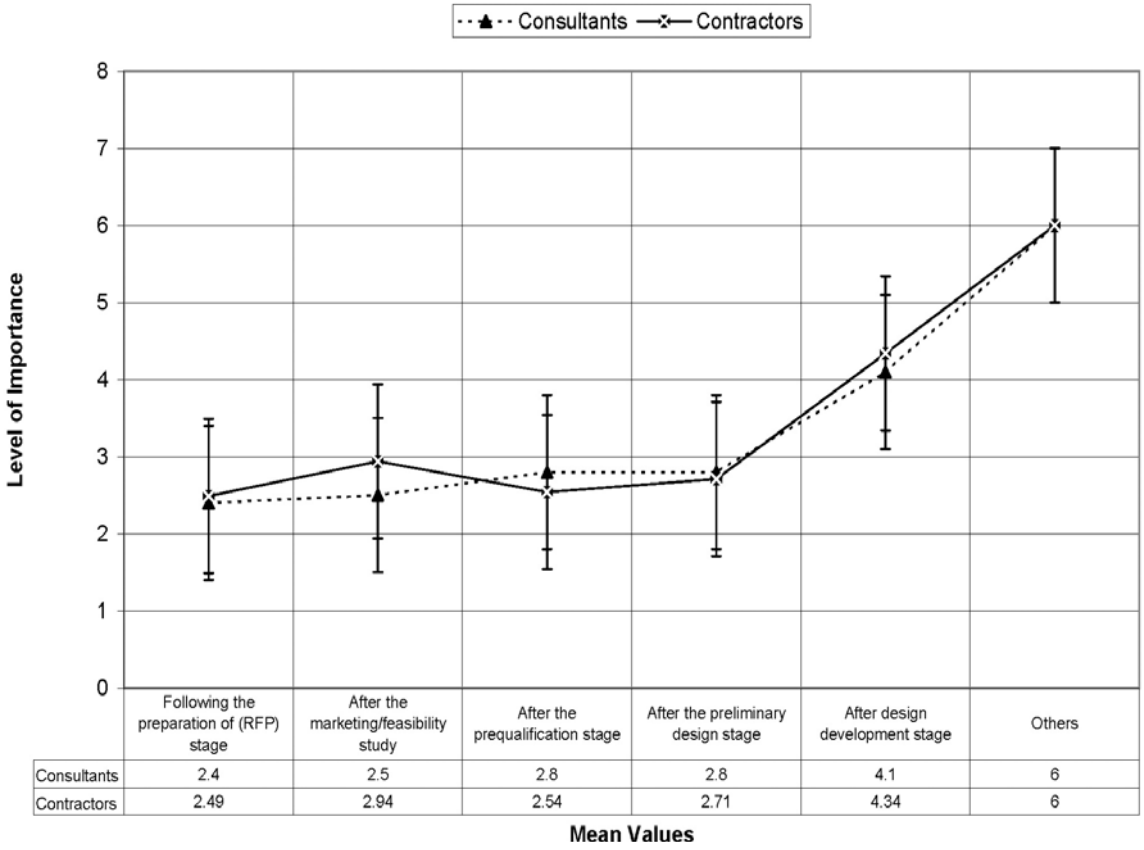


Figure 5.4.1. The Results of Each Group Indicating the Stages of the Project life Cycle at which, their Clients Generally Invite them to D&B Projects.

4.1.2 Comments:

The results depicted in **Figure 5.4.1** did not come with surprises and in fact confirmed what was reported in the literature review. The process of selecting D&B firms is not always based on the two stage prequalification selection. However, consulting and contracting firms provided similar responses in terms of their involvement with D&B projects and the stage when local construction industry clients approach them. Both

groups reported that clients invite them to D&B projects immediately after the RFP document of the project is prepared. This was the first answer from consulting firms with a Mean value of (2.46) and for contracting firms with a Mean of (2.49). From thereon the picture became different. For consulting firms (After the marking/feasibility stage) ranked second whilst (After the Prequalification stage) ranked third.

For contracting firms the second answer was (After the prequalification stage) with Mean (2.54) and (After preliminary stage) came third with a Mean value of (2.71). Both groups had similar rating for (After design development stage).

What is noticeable here is that some clients apply the two stage prequalification selection process referred to in the literature review. The results show that qualified contractors are invited to the two stage bidding process and the final contractor's selection is not based purely on cost. This prequalification process was not as highly rated with consulting firms. This choice was ranked third on a six point scale. The ***t*** test, group statistics table which shows descriptive statistics for the two groups, and the independent sample test (Levene test) do not show any significant statistical variations **(sig≤.05)** and therefore the results can be within 95% confidence level.

CONSULTANTS / CONTRACTORS

4.2 Have you encountered any problem when working on Design and Build project that discourage you from accepting new Design and Build contracts?

High ◄——————————► *Low*

1. Yes	1	2	3	4	5
2. Occasionally	1	2	3	4	5
3. No	1	2	3	4	5
4. In specific circumstances	1	2	3	4	5
5. Other (please specify)	1	2	3	4	5

4.2.1 Purpose

The purpose of this question is to study the opinion of both groups with respect to the problems encountered when procuring D&B projects. The answers will provide insight data about the sample's understanding and perception of this project delivery option from risk standpoint as well as the implication of this on their business decisions and future contractual agreement.

4.2.2 Responses

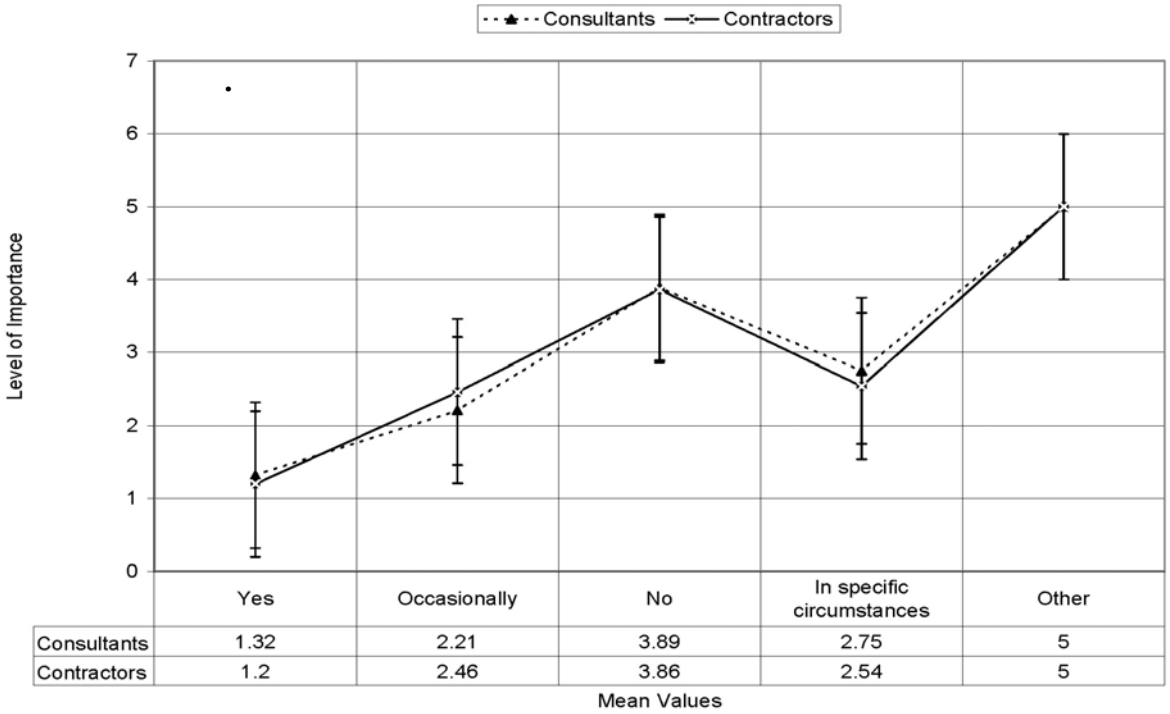


Figure 5.4.2. The Results of Each Group about Problems Encountered when Working on D&B Project that Discourage them from Accepting New D&B Contracts.

4.2.3 Comments:

The answers shown **Figure 5.4.2** present two sets of explanations. First, they indicated the participants' response to whether or not the D&B approach presents problems to them. The second set of answers is the scale and level of significance of these problems. The majority of the consulting and contracting firms agreed with the first category (Yes) indicating that they faced problems when working under a D&B approach. The consulting firms confirmed this with (85.7%) of responses on the highest level of the scale and a Mean value of (1.32). Also contractors concurred with (91.4%) of the highest level of the scale with a Mean value of (1.2). The results also show that the sample reported a high percentage for the second category of (occasionally) with (78.6%) answers from the consulting firms with a Mean value of (2.20) and (43%) from the contracting firms and a Mean value of (2.46) respectively. Lower percentages were reported for the third category (No) problems with a D&B project approach and with lower ratings on the five point scale. This means that all participants agreed that there are problems associated when procuring D&B option. These results confirm that the majority of the results acknowledge the presence of the problems when procuring D&B

project delivery option. These results corroborate with the literature review. Past studies have indicated that D&B delivery option requires specific knowledge, experience and a mind set to succeed. Otherwise, the process can have inherent challenges that may lead to unpleasant consequences.

CONSULTANTS / CONTRACTORS

4.3 Do you think that your clients are aware of the Design and Build accelerated design programs?

1.	**Fully aware**	2.	**Fairly aware**	3.	**Neutral**	4.	**Vaguely aware**	5.	**Unaware**
	☐		☐		☐		☐		☐

4.3.1 Purpose

This attitudinal question is intended to shed some light on the opinions of these consultants and contractors regarding how they assess the awareness and understanding of their clients with the accelerated program associated with the D&B contracting. The answers are meant to provide data regarding the level of risk and/or confidence that these key participants consider and expect when embarking on D&B projects.

4.3.2 Responses

			Groups	
			Consulting Firms	Contracting Firms
siv4.3 Do you think that your Clients are aware of Design and Build accelerated design programs?	1 Fully aware	Count	3	1
		% of Total	10.7%	2.9%
	2 Fairly aware	Count	9	3
		% of Total	32.1%	8.6%
	3 Neutral	Count	8	3
		% of Total	28.6%	8.6%
	4 Vaguely aware	Count	7	23
		% of Total	25.0%	65.7%
	5 Unaware	Count	1	5
		% of Total	3.6%	14.3%
Total		Count	28	35
		% of Total	100.0%	100.0%

4.3.3 Comments

The answers were not in compliance with question 3.4 results. Consultants indicated with twenty five percent (25%) of the responses that their clients are (Vaguely aware) of the D&B option and the contractors responded to the same question with an overwhelming majority over sixty five percent (65.7%). The majority of the consultants answered that their clients are (Fairly aware) of this accelerated program with over thirty two percent (32.1%) compared with only (8.6%) of the contractors' responses. Similarly, over twenty eight percent (28.6%) of the consultants were undecided and believed that their clients were neither aware nor unaware compared with eight point six percent (8.6%) of the contractors' answers. Both groups agreed that their clients are not fully aware of the special demand of D&B accelerated program.

Taken as one group, these industry participants answered with an overwhelming majority of forty seven point six percent (47.6 %) that their clients vaguely understand the special program requirements of the D&B project delivery option. In question 3.4 the joint results indicated that the industry is familiar with the D&B project delivery option for more than 15 years. These results confirm the data found in the literature review. Al Mansouri (1998), Jannadi (1997), Amjad (2003), Alhazmi *et al.* (2000) reported that the D&B option is well known locally and many key participants are familiar with it. However, the above responses reveal that the majority of the consultants and contractors are of the opinion that their clients are still unaware of this delivery option. The results indicate a gap exists between what consultants and contractors believe regarding the knowledge of their clients with D&B option. **Figure 5.4.3** presents the results.

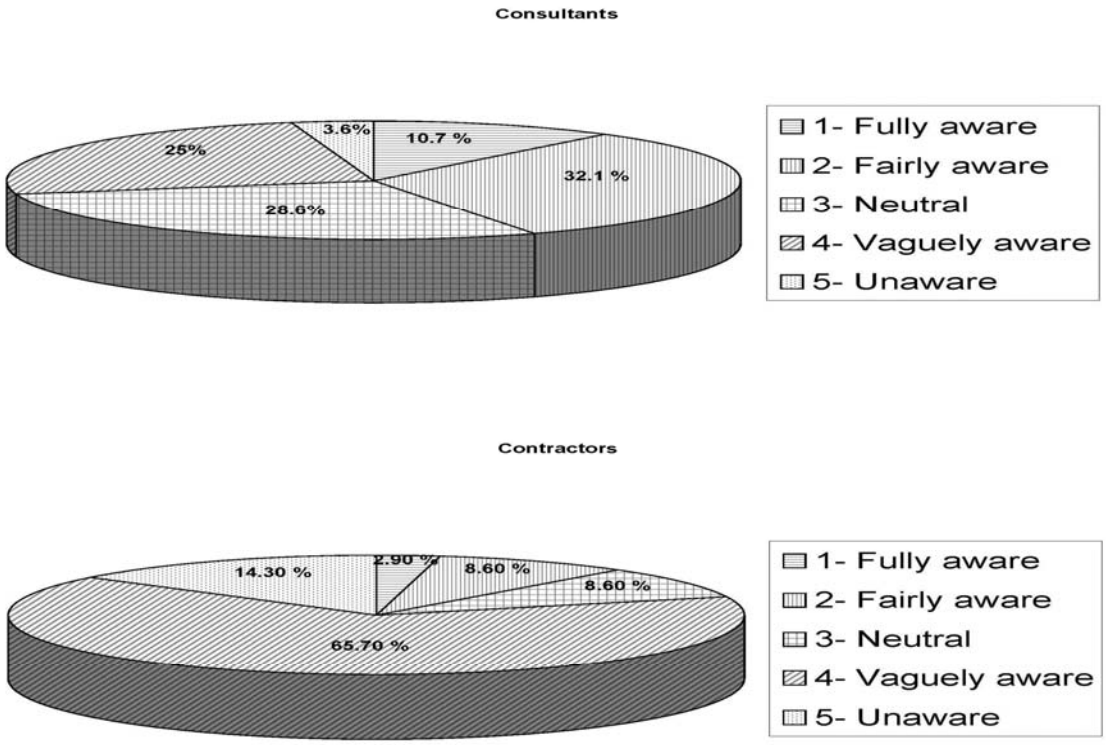


Figure 5.4.3. The Results of the Group on the Level of their Clients' Awareness with the D&B Accelerated Design Programs.

CONSULTANTS / CONTRACTORS

4.4 Do you think that your clients are aware of, and in agreement with the expected number of design changes associated with D&B projects and the impact of this on the project cost and time?

1.	2.	3.	4.	5.
Fully aware	**Fairly aware**	**Neutral**	**Vagu-ely aware**	**Unaw-are**
☐	☐	☐	☐	☐

4.4.1 Purpose

The purpose of this question is similar to the previous question. It is to establish the clients' level of awareness towards the ongoing changes and expected modifications associated with the D&B option. Also, it shall indicate the client's awareness of the financial implication due to the continuous design changes that are expected when procuring D&B projects. The answers are intended to reveal any relevant disputes or sources of disagreement that are perceived to be inherent in the D&B process.

4.4.2 Response

			Groups	
			Consulting Firms	Contracting Firms
siv4.4 Do you think that your Clients are aware of, and in agreement with the expected number of design changes associated with Design and Build projects?	1 Fully aware	Count	6	2
		% of Total	21.4%	5.7%
	2 Fairly aware	Count	8	13
		% of Total	28.6%	37.1%
	3 Neutral	Count	6	12
		% of Total	21.4%	34.3%
	4 Vaguely aware	Count	7	6
		% of Total	25%	17.1%
	5 Unaware	Count	1	2
		% of Total	3.6%	5.7%
Total		Count	28	35
		% of Total	100.0%	100.0%

4.4.3 Comments:

The answers are not similar to the previous question due to a noticeable difference.

On the first category, (Fully aware), (21%) majority of the consultants are of the opinion that their clients are fully aware of this project delivery option compared with only (5.7%) of the contractors' responses. On the second category (Fairly Aware), twenty eight percent (28%) majority of the consultants and thirty seven percent (37%) of the contractors' are of the opinion that their clients are fairly aware of the expected design changes. Contractors however, are less certain about the level of understanding that their clients have about D&B option. **Figure 5.4.4** gives a graphical representation of these results. The results tell us that fifty percent (50%) of the consultants and forty three percent (43%) of the contractors confirm that their clients are aware of the expected design changes and the impact of this option on time and cost. Therefore, it can be inferred that the majority of construction industry clients embark on D&B option with prior knowledge of what to expect from the process and its impact on cost, time.

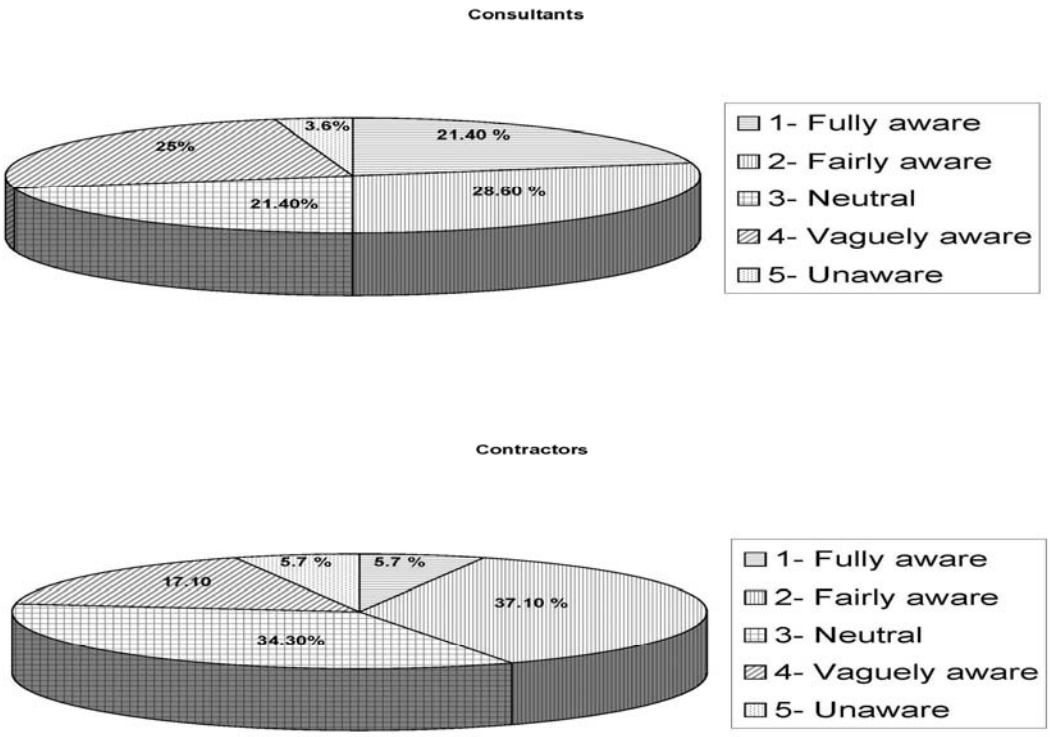


Figure 5.4.4. The Groups' Response to the Level of Clients' Awareness of D&B Projects and Agreement with the Expected Number of Design Changes.

CONSULTANTS / CONTRACTORS

4.5 Why do your clients choose D&B option? Please indicate in a priority order the objectives of the clients for choosing D&B option.

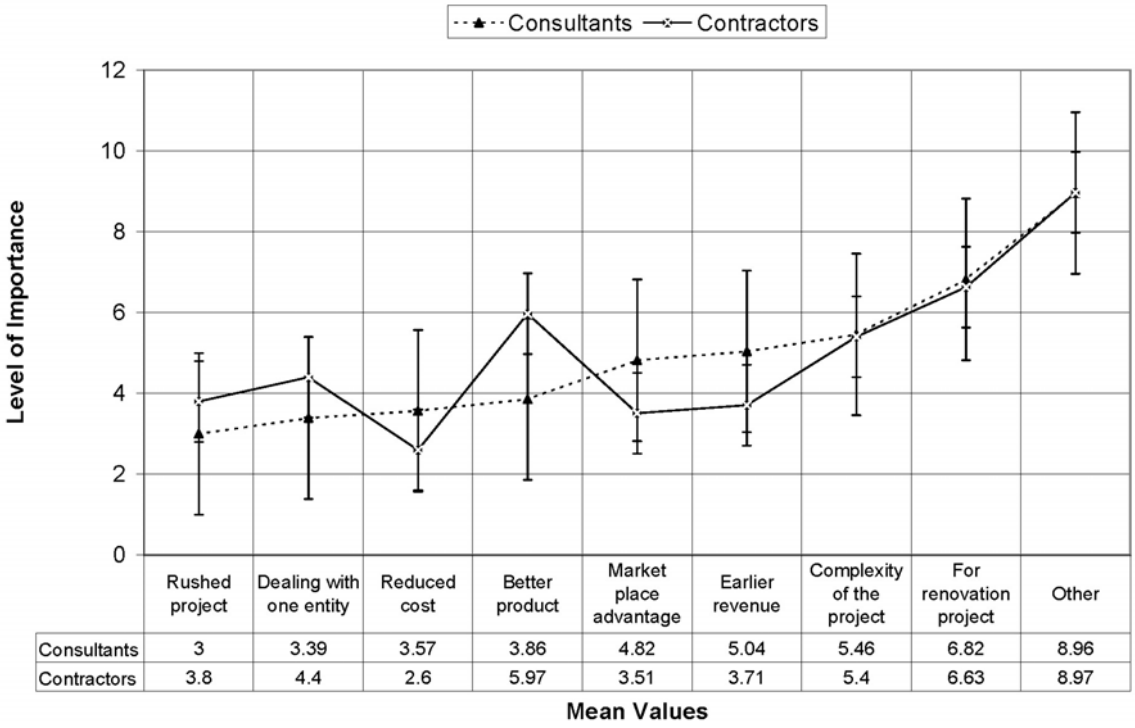
High ⟷ *Low*

1. Market place advantage	1	2	3	4	5	6	7	8	9
2. Earlier revenue	1	2	3	4	5	6	7	8	9
3. For renovation project	1	2	3	4	5	6	7	8	9
4. Rushed project	1	2	3	4	5	6	7	8	9
5. Complexity of the project	1	2	3	4	5	6	7	8	9
6. Reduced Cost	1	2	3	4	5	6	7	8	9
7. Better product	1	2	3	4	5	6	7	8	9
8. Dealing with one entity	1	2	3	4	5	6	7	8	9
9. Other, (Please Specify)	1	2	3	4	5	6	7	8	9

4.5.1 Purpose

The purpose of these questions is to find out why clients request the D&B option and the reasons behind this selection. This question will unveil the motives and reasons that lead clients to select D&B option and their justification for this.

Responses



	Rushed project	Dealing with one entity	Reduced cost	Better product	Market place advantage	Earlier revenue	Complexity of the project	For renovation project	Other
Consultants	3	3.39	3.57	3.86	4.82	5.04	5.46	6.82	8.96
Contractors	3.8	4.4	2.6	5.97	3.51	3.71	5.4	6.63	8.97

Figure 5.4.5. The Results from Each Group about Why Clients Choose D&B Option

4.5.2 Comments:

The answers shown in **Figure 5.4.5** did not align with expectations. Priorities and perceived reasons differ between the two groups. Consultants reported that their clients invite them to procure D&B projects for reasons of (Speed) as the first choice with Mean value of (3.00). Reasons of (Integrated approach dealing with one entity) is rated as a second choice with a Mean of (3.39) followed by reasons of (Reduced cost) with a Mean of (3.57) and for (Better quality) with a Mean of (3.86).

Contractors, however, answered with different priorities to this question. They reported that clients approach them for procuring D&B projects for reasons of (Reduced cost) as the first choice with (77.1%) and Mean of (2.60). The second choice was (Market place advantage) with (45.7%) and Mean value of (3.51). Earlier revenues came third with (54.3%) and Mean value of (3.71). Rushed projects and speed came in the fourth place with (48.5%) of the answers and a Mean value of (3.80).

The results reflect different clients' objectives and significant perceptions between consultants and contractors. When clients approach contractors their objectives in terms of priority are to achieve reduced cost, market place advantage, earlier revenues and speed. These reasons are mainly cost and financial oriented. On the other hand, when

clients approach consultants, their reasons are mainly to achieve speed, integrated approach, reduced cost and better quality.

As can be seen from the consultants' answers, clients target speed, the ability to deal with one entity, and better quality. These reasons indicate a balanced approach which is not just cost oriented. These answers suggest that when clients approach the construction industry they have different objectives and reasons. They approach contractors for speed and financial reasons and consultants for cost, an integrated approach, and better quality. The complexity of the project did not receive many high level points with Means value at (5.46) for consultants and (5.40) for contractors. However, the T-Test Levene results show that four categories are statistically significant (sig≤.05).

1. Market place advantage
2. Earlier revenues
3. Better product
4. Dealing with one entity

Section V: Observations and Recommendations for the Future (Please tick ✓ the appropriate answer) indicate in priority order.

5.1 What are the nature of impediments to the application of Design and Build contracting?

CONSULTANTS / CONTRACTORS *High* ⟷ *Low*

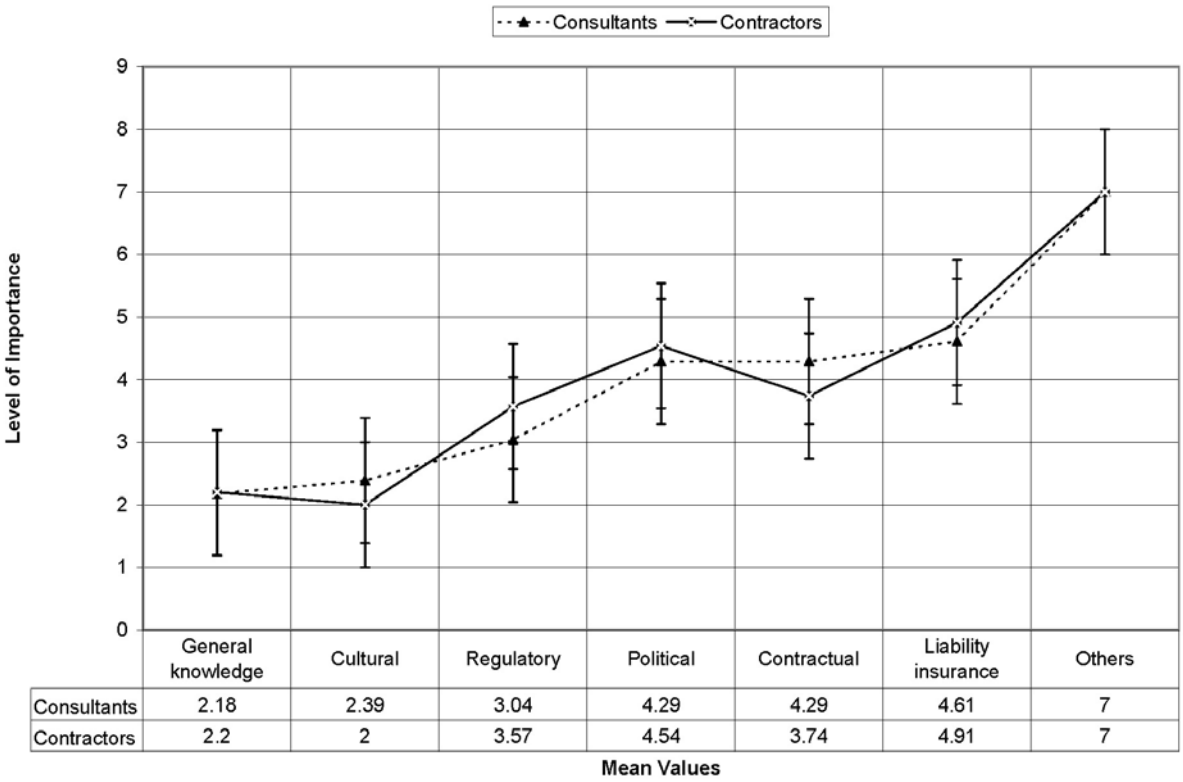
1.	General Knowledge	1	2	3	4	5	6	7
2.	Cultural	1	2	3	4	5	6	7
3.	Political	1	2	3	4	5	6	7
4.	Contractual	1	2	3	4	5	6	7
5.	Regulatory	1	2	3	4	5	6	7
6.	Liability insurance	1	2	3	4	5	6	7
7.	Others, (please specify below)	1	2	3	4	5	6	7

5.1.1 Purpose

This is a critical question that points a finger at the problems that the sample participants perceive as the impediments to the selection of D&B option in the Saudi

Construction Industry. It ranks the response of the sample participants with respect to their views, opinion and knowledge about the problems encountered which stand as clear impediments to the adoption of procuring D&B option. The priorities indicate the type, nature and category of problems associated with D&B project delivery option. This question has an open-ended part.

5.1.2 Responses



	General knowledge	Cultural	Regulatory	Political	Contractual	Liability insurance	Others
Consultants	2.18	2.39	3.04	4.29	4.29	4.61	7
Contractors	2.2	2	3.57	4.54	3.74	4.91	7

Figure 5.5.1. The Results of the Nature of Impediments to the Application of D & B Option.

5.1.3 Comments:

Consistent and matching results were received for this question. Both groups provided almost identical answers for each category as shown in **Figure 5.5.1**. Consultants believe that (Lack of general knowledge) is the first important impediment to the adoption of D&B option. This is the choice of the majority of eighty six percent (86%) and with Mean value of (2.18). The second criteria of impediments was (Cultural) with a majority of seventy five percent (75%) and with Mean value of (2.39). The third impediment was (Regulatory) with sixty four percent (64%) majority and with Mean of (3.04).

Contractors on the other hand believe that (Cultural) reasons are the first reason for the impediments of adoption of D&B option with a majority of over ninety one percent (91.4%) and with Mean value of (2.00). In the second place came (Lack of general knowledge) with a majority of (85.8%) and with Mean value of (2.20). The third criterion of impediments was (Regulatory) with over forty five percent (45.7%) majority and with Mean value of (3.57). These answers are important for two reasons:

- First, clients approach the consulting and contracting firms as seen in the previous question for different reasons. The answers of both groups regarding the perceived impediments are consistent and reflect the views of the majority of the sample. The Levene test shows no statistical significance and violation.
- Second, these impediments are perceived by these participants as hindering the adoption of the D&B option. This is regardless of their level of involvement with D&B option and is based on their understanding of these impediments.

5.2 Whether you have in the past or not, at what stage would your firm accept to be part of the Design and Build project delivery team? Please indicate in a priority order.

CONSULTANTS	*High* ← → *Low*						
1. Only if we know the client well	1	2	3	4	5	6	7
2. Only if we select the contractor	1	2	3	4	5	6	7
3. Subject to agreement on contract conditions, schedule and budget.	1	2	3	4	5	6	7
4. Only if we jointly prepare the contract with the contractor	1	2	3	4	5	6	7
5. Subject to project type	1	2	3	4	5	6	7
6. Only if there is an experienced client representative on site.	1	2	3	4	5	6	7
7. If the scope and client requirements are clear	1	2	3	4	5	6	7
8. Other, (please specify)	1	2	3	4	5	6	7

		High						*Low*
CONTRACTORS								
1.	Only if we know the client well	1	2	3	4	5	6	7
2.	Only if we select the designer	1	2	3	4	5	6	7
3.	Subject to agreement on contract conditions, schedule and budget.	1	2	3	4	5	6	7
4.	Only if we jointly prepare the contract with the designer.	1	2	3	4	5	6	7
5.	Subject to project type	1	2	3	4	5	6	7
6.	Only if there is an experienced client representative on site.	1	2	3	4	5	6	7
7.	If the scope and client requirements are clear	1	2	3	4	5	6	7
8.	Other, (please specify)	1	2	3	4	5	6	7

5.2.1 Purpose

This question has some variations and is presented here as two sets of questions, one for the consultants and another for the contractors with a slight variation (Variable 2 and 4). These questions are meant to test the readiness of the sample to engage in D&B option.

5.2.2 Responses

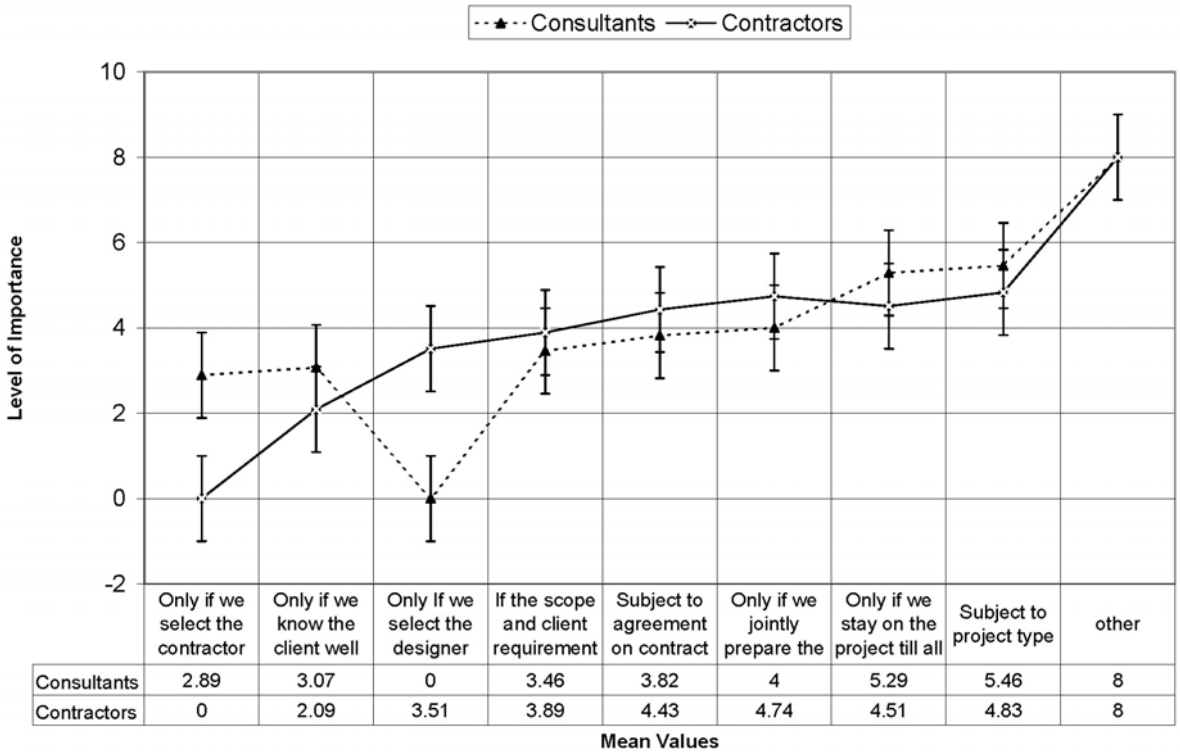


Figure 5.5.2. The Results Showing at What Stage the Sample Firms Accept to be Part of the Design and Build Delivery Team.

5.2.3 Comments

The results in **Figure 5.5.2** show that the answers are comparable in terms of priorities and categories of the variables. Consultants appear to be keen to the criteria of (Only if we select the contractor) for the D&B team. They selected this as the first priority with a majority of sixty four percent (64.3%) and with Mean value of (2.89). The second important criterion was; (Knowing the client well). This choice received a majority of sixty one percent (61%) and with a Mean value of (3.07). The third criterion is (If the scope and client requirements are clear). The consultants selected this with fifty four percent (54%) majority and with a Mean value of (3.46). Contractors on the other hand are more interested in the criterion of (If we know the client well). This was their first choice and a majority of eighty three percent (83%) and with a Mean value of (2.09). The second criterion for accepting to participate in D&B option was (If we select the designer). This choice is second with a majority of fifty one percent (51.4%) and with Mean of (3.51). The third selection was (If the scope and client's requirements are clear). The contractors selected this with (48.5%) majority and with Mean of (3.89). The answers tell us that both groups perceive the following criteria as most important:

- Knowing the client.
- Selecting the designer by the contractors and selecting the contractor by the designers
- Reaching and agreement on the scope, budget and program

These criteria were ranked as the top four and most important in terms of priorities for both groups. However, the **T-Test** Levene results show that three categories are statistically significant **(sig≤.05).**

1. Only if we Know the Client well
2. Only if we stay on the project till all design works are complete
3. If the scope and client's requirements are clear.

5.3 What are the main problems that your firm encounters when asked to deliver projects along the D&B option? Please indicate in a priority order which of the following variables present more problems.

CONSULTANTS

High ◄——————————► *Low*

1.	Lack of financial compensation	1	2	3	4	5	6	7	8	9	10	11
2.	Continuous planning to cope with site activities	1	2	3	4	5	6	7	8	9	10	11
3.	Maintaining the acceptable standard of design	1	2	3	4	5	6	7	8	9	10	11
4.	Unable to discuss with the client the design brief.	1	2	3	4	5	6	7	8	9	10	11
5.	Staying too long in the project	1	2	3	4	5	6	7	8	9	10	11
6.	Always avoiding rework, time and cost overrun	1	2	3	4	5	6	7	8	9	10	11
7.	Having to shield the continuous contractor's queries.	1	2	3	4	5	6	7	8	9	10	11
8.	Having to allow the over estimated space requirements	1	2	3	4	5	6	7	8	9	10	11
9.	Lack of clear clients requirements	1	2	3	4	5	6	7	8	9	10	11
10	Lack of trained professional resources.	1	2	3	4	5	6	7	8	9	10	11
11.	Insurance liabilities are not clear.	1	2	3	4	5	6	7	8	9	10	11

CONTRACTORS

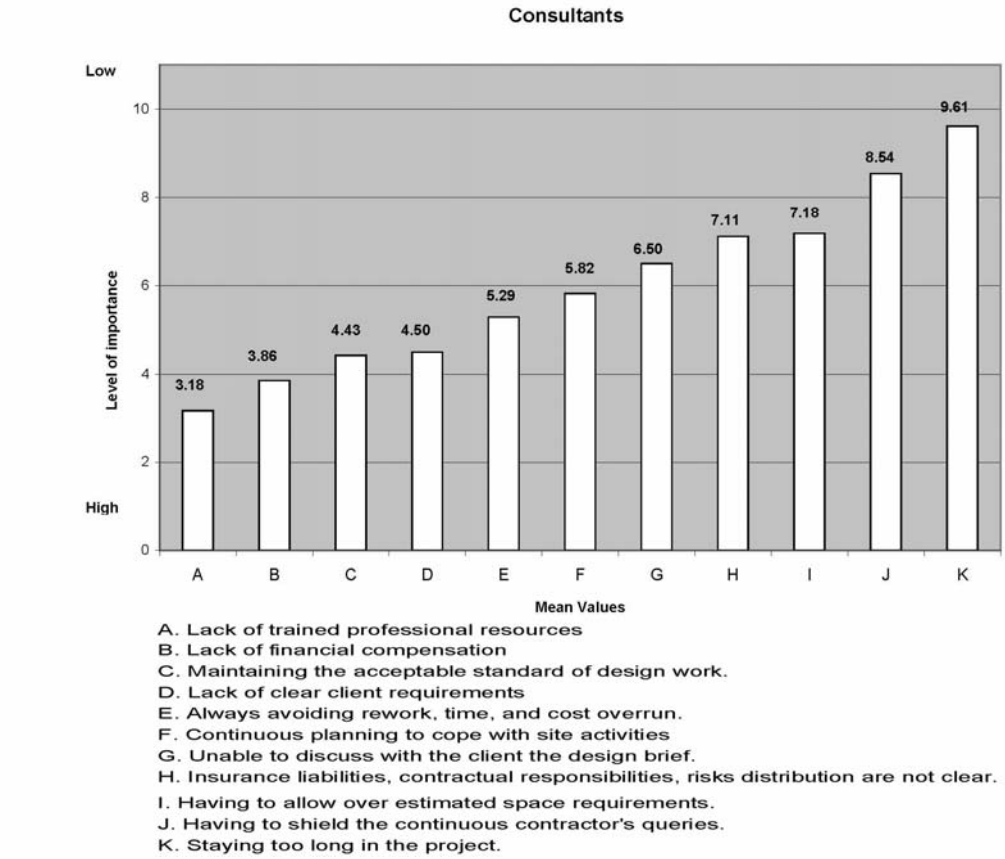
High ◄——————————► *Low*

1.	Lack of financial compensation	1	2	3	4	5	6	7	8	9	10	11
2.	Continuous planning to cope with site activities	1	2	3	4	5	6	7	8	9	10	11
3.	Maintaining the acceptable standard of design	1	2	3	4	5	6	7	8	9	10	11
4.	Unable to discuss with the client the design brief.	1	2	3	4	5	6	7	8	9	10	11
5.	Staying too long in the project	1	2	3	4	5	6	7	8	9	10	11
6.	Always avoiding rework, time, and cost overrun	1	2	3	4	5	6	7	8	9	10	11
7.	Having to shield the continuous consultant's changes.	1	2	3	4	5	6	7	8	9	10	11
8.	Having to allow the over estimated space requirements	1	2	3	4	5	6	7	8	9	10	11
9.	Lack of clear clients requirements	1	2	3	4	5	6	7	8	9	10	11
10	Lack of trained professional resources.	1	2	3	4	5	6	7	8	9	10	11
11.	Insurance liabilities are not clear.	1	2	3	4	5	6	7	8	9	10	11

5.3.1 Purpose

This is question examines the types of problems that both groups encounter at the operational level when delivering D&B projects. The respondents are asked to rank and weigh the responses with respect to their views, experience and practical knowledge concerning the problems encountered while procuring D&B projects. The priorities will indicate the type, nature and category of problems associated with D&B option. This question is intended to provide some answers regarding the constitution of the problems in procuring D&B projects. The same question is directed to both groups with slight modifications on variable (7).

5.3.2 Responses



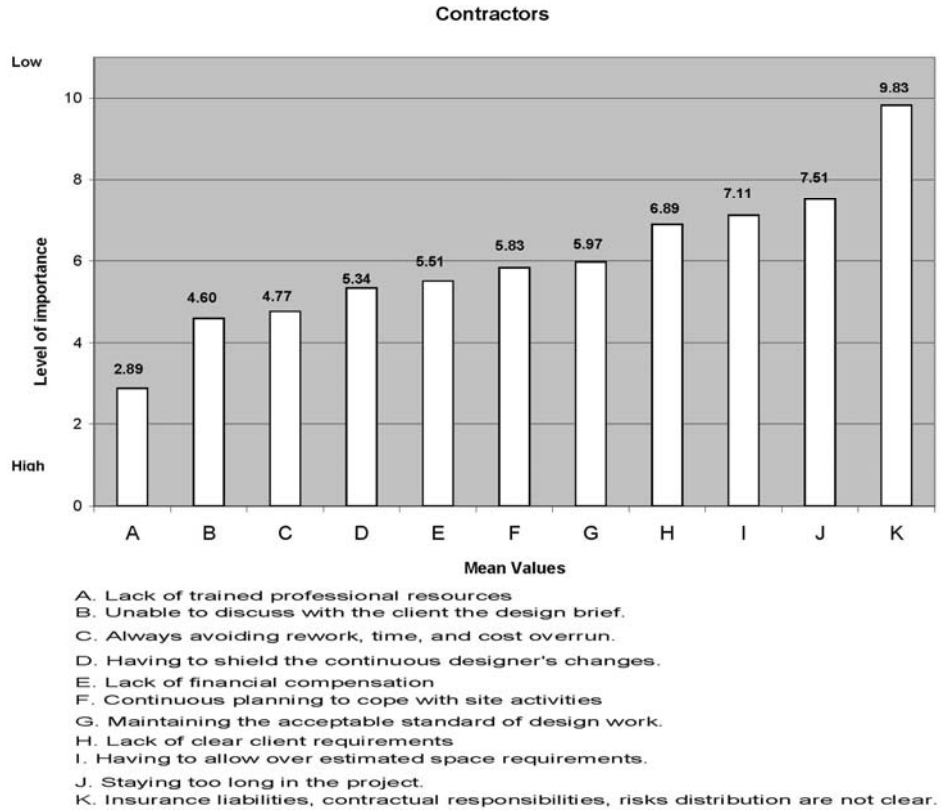


Figure 5.5.3 The Results of the Main Impediments to the Adoption of Design and Build Project Delivery Option Reported by Each Group.

5.3.3 Comments

Generally, there are significant differences in the results as shown in **Figure 5.5.3** for each group, unlike the answers from the previous question. However, both groups had the same answer for what they considered the first and most important choice answered (Lack of trained professional resources). The remaining answers differ. Then the groups meet again at the criterion dealing with (Having to allow over estimated space requirements) shows the ranking for each group. The ranking of the three most important answers came as follows:

Consultants believe with a high majority and with a Mean value of (3.18) that (Lack of professional D&B resources) as being the top most significant problem they face when working with the D&B option.

The second problem area they encounter is (Lack of financial compensation). This problem was second in ranking with a Mean value of (3.86).

The third problem area is (Maintaining an acceptable standard of design work). The consultants selected this with a Mean of (4.43).

Apart from the lack of trained resources, the contractors seem to encounter different types of problems. Contractors agree with consultants and believe with the highest majority and a Mean value of (2.89) that (Lack of professional D&B resources) as being the top most significant problem they face when working with the D&B option.

The second problem areas they face is (Unable to discuss with the client the design brief). This problem was second in ranking with a Mean value of (4.60).

The third problem area is (Always avoiding rework, time and cost overrun). The contractors selected this with a third majority and with a Mean value of (4.77).

On a closer look the answers confirm what was reported in the literature review. The problems that consultants are concerned with are:

- The qualified and trained resources, Amjad (1998).
- Proper financial rewards.
- Maintaining good quality standards Al Mansouri (1988).
- Avoiding rework in the other hand. Reported by Assaf *et al.* (1995).
- Not having a clear client brief Al Barrak (1993).

Surprisingly, for the consultants, problems associated with insurances, liabilities and understanding the brief which Friedlander (1998), refereed to was ranked in the middle of the spectrum. Answers from the contractors also are in line with the findings of the literature review. The answers they related include:

- Unable to discuss the design brief with the client;
- Avoiding rework. Rehemi (1983).
- Controlling and reducing the designers' changes.
- Lack of financial compensation.
- Having to keep re-planning to cope with site activities. Al Sultan (1987).

However, the T-Test Levene results show that three categories are statistically significant (sig≤.05).

1. Only if we know the Client well
2. Only if we stay on the project till all design works are complete
3. If the scope and client's requirements are clear

5.4 What makes the traditional project delivery system an attractive choice for you? Please indicate in a priority order

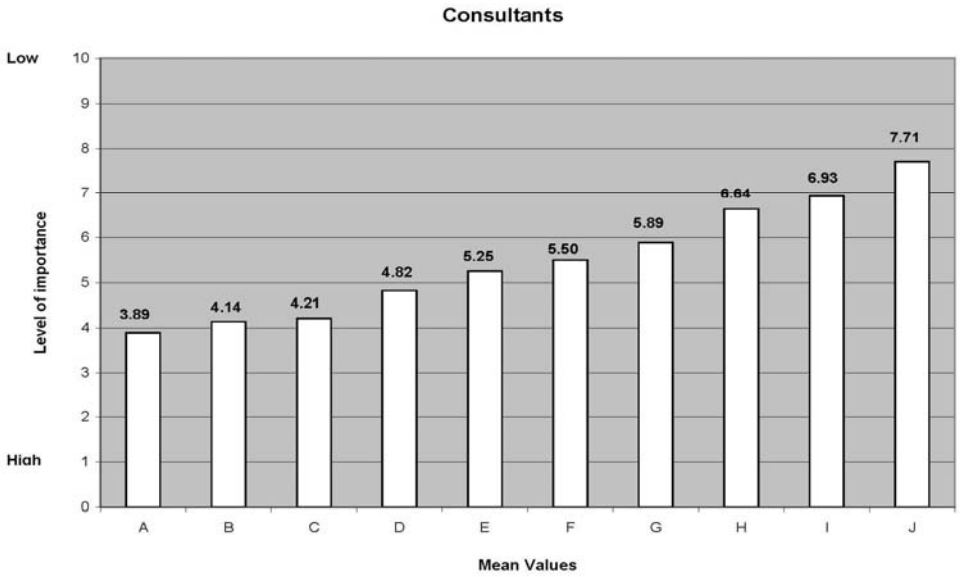
CONSULTANTS / CONTRACTORS *Higher* ⟷ *Lower*

1.	Clear comprehensive client brief.	1	2	3	4	5	6	7	8	9	10
2.	Lack of many qualified Design and Build firms.	1	2	3	4	5	6	7	8	9	10
3.	Many consultants prefer not to work for contractors.	1	2	3	4	5	6	7	8	9	10
4.	Contractual Responsibilities /duties/ Obligation / risk distribution are clear.	1	2	3	4	5	6	7	8	9	10
5.	Familiarity with the traditional system.	1	2	3	4	5	6	7	8	9	10
6.	Insurance and liabilities clauses are clear.	1	2	3	4	5	6	7	8	9	10
7.	Some clients do not feel comfortable dealing directly with contractors and prefer dealing with consultant.	1	2	3	4	5	6	7	8	9	10
8.	Design document checked systematically for coordination, errors and compliance to specifications.	1	2	3	4	5	6	7	8	9	10
9.	Less coordination problems compared to other project delivery systems.	1	2	3	4	5	6	7	8	9	10
10	No pressure from contractors, to design differently to meet site demands.	1	2	3	4	5	6	7	8	9	10

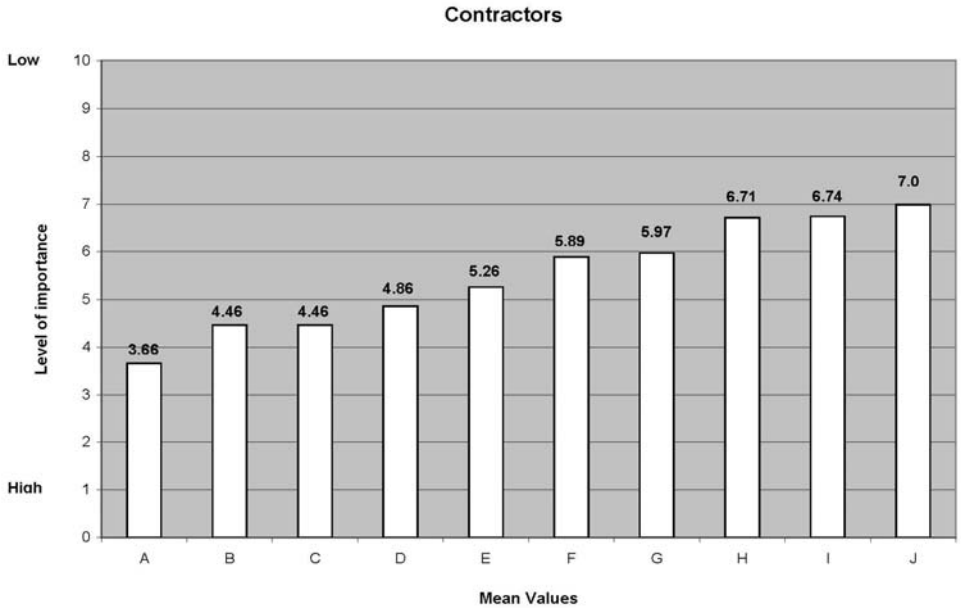
5.4.1 Purpose

The purpose of this question is to establish the reasons that make the traditional project delivery option an attractive choice for both groups. This question is important to the research investigation. It exposes a number of issues that were addressed in the literature review. It also stands as a complementary question to question 5.1 and to the next questions 5.5 and 5.6 and 5.7. It is the author's belief that once the key points that make the industry participants feel comfortable with the traditional project delivery option known and the gaps are determined, then, the main impediments to the adoptions of the D&B options can be easily identified.

5.4.2 Responses



A. Contractual Responsibilities /duties /Obligation / risk distribution are clear.
B. Familiarity with the traditional system compared with D/B option.
C. Clear comprehensive client brief.
D. 48 Design document checked systematically for coordination, errors and compliance to specifications.
E. Less coordination problems compared to other project delivery systems.
F. Lack of many qualified Design and Build firms.
G. Many consultants prefer not to work for contractors.
H. Insurance, liability, and contractual clauses and regulations are clear.
I. Some clients do not feel comfortable dealing directly with contractors and prefer dealing with consultant.
J. No pressure from contractors, to design differently to meet site demands.



A. Many consultants prefer not to work for contractors.
B. Less coordination problems compared to other project delivery systems.
C. Lack of many qualified Design and Build firms.
D. Some clients do not feel comfortable dealing directly with contractors and prefer dealing with consultant.
E. Design document checked systematically for coordination, errors and compliance to specifications.
F. Familiarity with the traditional system compared with D/B option.
G. Contractual Responsibilities /duties /Obligation / risk distribution are clear.
H. Clear comprehensive client brief.
I. No pressure from contractors, to design differently to meet site demands.
J. Insurance, liability, and contractual clauses and regulations are clear.

Figure 5.5.4. The Results Reported by the Groups on the Factors that Make the Traditional Project Delivery Option an Attractive Option.

5.4.3 Comments

The analysis of the results shows significant differences in the results received from each group. The results give an alarming signal. There seems to be major disagreement among the groups in the ranking of the criteria that makes the traditional option an attractive one. Both groups do not appear to agree or share any variable or significant area of concern. **Figure 5.4.3** shows the spread of answers when performing the statistical analysis. For the consultants, the ranking of the three most important answers came as follows:

Consultants believe with the highest majority and with a Mean value of (3.89) that (The clarity of contractual responsibilities/duties/risk) is the top most attractive criterion for the traditional option.

The second attractive area they reported is (Familiarity with the traditional system compared with the D&B option). This criterion was second in ranking with a frequency of majority and with a Mean value of (4.14).

The third attractive area is (Having clear and comprehensive client brief). The consultants selected this with a Mean value of (4.21).

The contractors on the other hand do not share the same views of the consultants. Their first three attractive areas sit in the middle of the range of the consultants. Contractors believe with the highest scored majority and with Mean value of (3.66) that many consultants prefer not to work for contractors) as being the most attractive option in the traditional path. This was noted in the literature review and reported by (Al Mansouri 1988) when he reported that contractors believe that consultants do not feel comfortable working for them. As a result, contractors use this opportunity to prove the consultants' inefficiency with the traditional option. They look to innovate when invited to the D&B option to prove their knowledge and experience.

The second attractive area they reported is (Less coordination problems compared with other project delivery system). Contractors admit here in ranking with a second majority and with a Mean value of (4.46) that the traditional option has less inherent coordination problems compared with another options. This finding was reported in the literature by Assaf *et al.* (1995).

The third problem area is (Lack of many qualified D&B firms). The contractors selected this with a Mean value of (4.46).

On a closer look, the answers confirm what was reported in the literature review.

The top four attractive criteria that the consultants find attractive in the traditional option are:

1. It offers clear contractual responsibilities of the parties involved.
2. Consultants are more familiar with the D.B.B option. Why risk another option.
3. They find the traditional option offering a clear design brief, Rehemi (1983).
4. The traditional path allows them to perform quality check regularly and avoid errors. This was confirmed in the literature review by (Assaf *et al.* 1995), on avoiding rework.

Contractors on the other hand stated that their views about what makes the traditional option attractive are the following:

1. Many consultants prefer not to work for contractors.
2. Contractors believe that with the traditional option there are less coordination problems.
3. The absence of D&B firms also makes the traditional path more attractive.
4. Some clients do not feel comfortable dealing directly with contractors and prefer dealing with consultants.

The results tell us that issues of liability and clarity of the responsibilities are more important to the consultants. Contractors believe the traditional path is popular because of cultural reasons since many clients and consultants do not prefer to work directly with contractors. This result is consistent with the results from contractors in question 5.1. Cultural reasons are considered by contractors to be one of the main impediments to the adoption of D&B option. Moreover, contractors believe that the absence of D&B firms makes the traditional path an attractive option. There is no real competition and equal alternatives. However, the T-Test Levene results show that five categories are statistically significant (sig≤.05).

1. Clear and comprehensive client brief. Familiarity with the traditional system
2. Many consultants prefer not work for the contractors.
3. Contractual responsibilities/duties/obligations/risk distribution is clear.
4. Some clients do not feel comfortable dealing directly with contractors and prefer dealing with consultants.

5.5 Please rank the following measures in order of priority that in your opinion will help D&B firms resolve some of Design and Build issues and make Design and Build project delivery system more attractive.

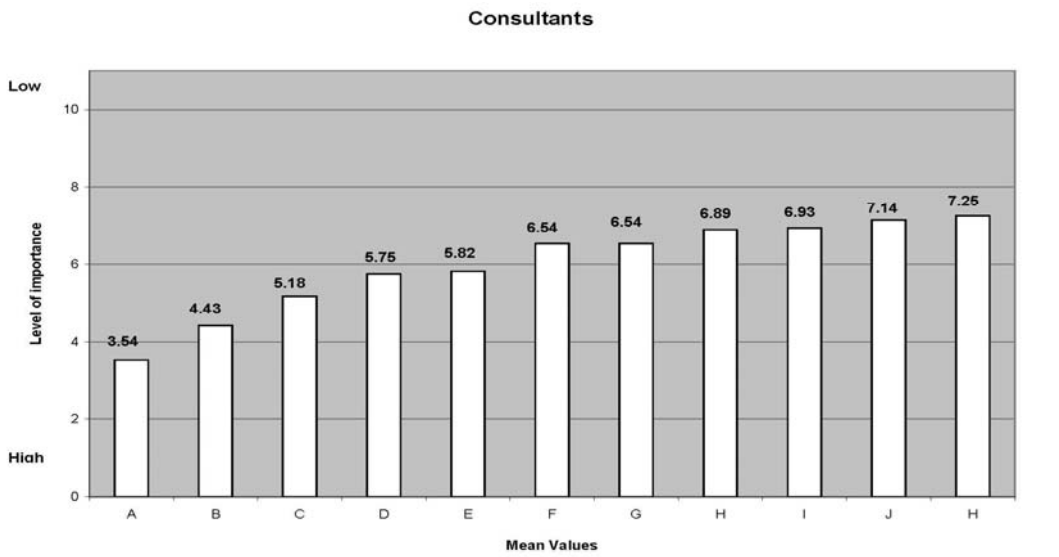
CONSULTANTS / CONTRACTORS

		High ←										→ *Low*
1	Introduction of revised building regulations and increase public awareness about D&B option	1	2	3	4	5	6	7	8	9	10	11
2	Set through planning the priorities of the work sequences and work quantities with agreement on site needs.	1	2	3	4	5	6	7	8	9	10	11
3	Having shared understanding of the scope of works.	1	2	3	4	5	6	7	8	9	10	11
4	Having an acceptable completion date with achievable milestone.	1	2	3	4	5	6	7	8	9	10	11
5	Having an experienced client representative and an experienced independent cost engineer on the project.	1	2	3	4	5	6	7	8	9	10	11
6	Agree contractual compensation changes formula.	1	2	3	4	5	6	7	8	9	10	11
7	Agree contractual clauses, for all parties to the contract.	1	2	3	4	5	6	7	8	9	10	11
8	Having in house experience in procuring Design and Build projects.	1	2	3	4	5	6	7	8	9	10	11
9	Involve the client in regular decision making meeting.	1	2	3	4	5	6	7	8	9	10	11
10	Be involved on the project from initiation to hand over.	1	2	3	4	5	6	7	8	9	10	11
11	Availability of qualified D&B contractors.	1	2	3	4	5	6	7	8	9	10	11

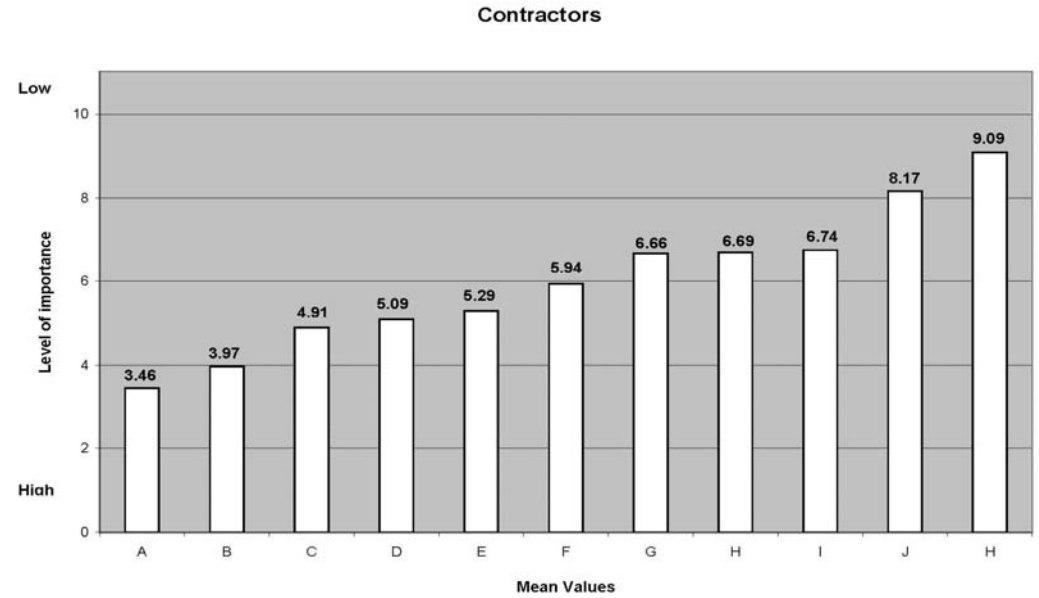
5.5.1 Purpose

This question proposes some effective measures that will improve the performance of the design firms in order to make the D&B project delivery option and attractive option. It is intended to evaluate measures that would assist consultants to cope with the time, planning and quality control challenges associated with D&B and fast-track project procurement. It will survey priorities that both groups consider as the measures to improve the popularity of D&B project delivery option.

5.5.2 Response



A. Having in house experience in procuring Design and Build projects.
B. Having shared understanding of the scope of works.
C. Agree contractual clauses, for all parties to the contract.
D. Be involved on the project from initiation to hand over.
E. Having an experienced client representative and an experienced independent cost engineer on the project.
F. Agree contractual compensation changes formula.
G. Availability of qualified D/B contractors.
H. Set through planning the priorities of the work sequences and work quantities with agreement on site needs.
I. Having an acceptable completion date with achievable milestone.
J. Introduction of revised building regulations and increase public awareness about Design and Build Option.
K.Involved the client in regular decision making meeting.



A. Availability of qualified D/B contractors.
B. Having shared understanding of the scope of works.
C. Having an acceptable completion date with achievable milestone.
D. Having an experienced client representative and an experienced independent cost engineer on the project.
E. Having in house experience in procuring Design and Build projects.
F. Set through planning the priorities of the work sequences and work quantities with agreement on site needs.
G. Agree contractual compensation changes formula.
H. Introduction of revised building regulations and increase public awareness about Design and Build Option.
I. Agree contractual clauses, for all parties to the contract.
J. Involved the client in regular decision making meeting.
K. Be involved on the project from initiation to hand over.

Figure 5.5.5. The Measures Reported in a Priority Order that will Help Design Firms Resolve Some of D&B Issues and Make D&B Option More Attractive.

5.5.3 Comments

The weighting and results received from both groups shown in **Figure 5.5.5** are similar to the previous results from question 5.4. All responses for each criterion were calculated to measure the collective voting and opinion of all the correspondents.

For the consulting firms the three most important factors reported by the consultants that would help design firms resolve some of the D&B issues and make the D&B option more attractive are:

The most important criterion is (Having in house experience in procuring D&B projects. The answers for this question showed the highest majority and a Mean value of (3.54). The second criterion of importance was the (Having shared understanding of the scope of works) with a Mean value of (4.43). Agreement on contractual clauses for all parties to the contract came third with the votes and a Mean value of (5.18).

Contractors provided different answers and priorities. Their first suggestion is (Availability of qualified D&B contractors). They believe that the industry lacks having qualified D&B contractors. The vote was the most important criterion and with a Mean value of (3.46). The second criterion of importance was (Having shared understanding of the scope of works) with a Mean value of (3.97). This is where both groups meet. The third criterion was (Having an acceptable completion date with achievable milestone). This factor was selected and with a Mean value of (4.91). The above results from both groups can be grouped further into five main categories in terms of priority and significance:

1. Having in house experience with procuring D&B projects.
2. Having understanding of the scope that is shared among all parties.
3. Having independent cost engineer to resolve financial issues.
4. Commitment to an acceptable schedule.
5. Availability of D&B firms.

The above five categories, if carefully verified, and accounted for would contribute to resolving the problems stated in the previous questions. However, the above results focus on a number of key issues which are to a great deal universal in nature. Having in house experience with D&B projects is a must for the proper running and controlling of any project. Having shared understanding and common goals takes many risks away and sets the method of achieving the end objectives. Experience comes from practice, learning and research, these activities are essential for the success of any project and in any industry. Independent cost engineers give assurance to all parties that there is no

bias in pricing and estimating actual works. However, the T-Test Levene results show that four categories are statistically significant (sig≤.05).

1. Having an acceptable completion date with achievable milestone
2. Having an In house experience in procuring D&B projects
3. Be involved in the project from initiations to handover
4. Availability of D&B contractors.

CONSULTANTS / CONTRACTORS

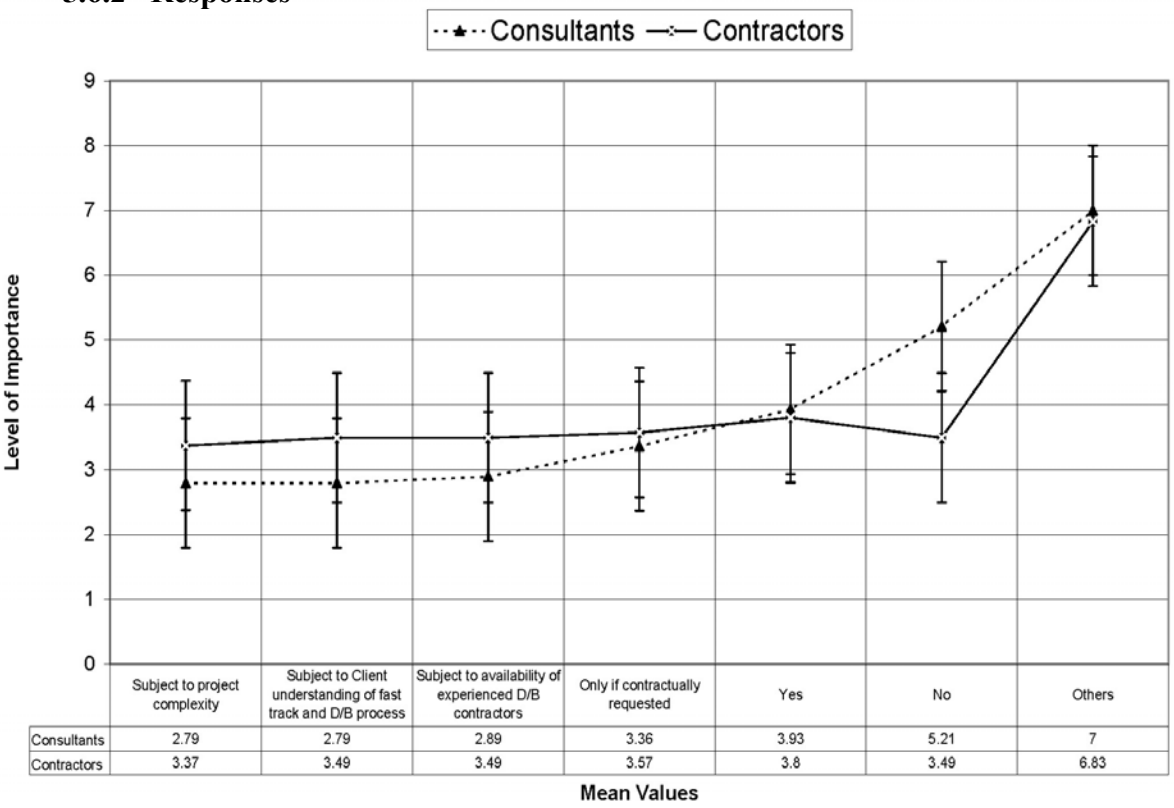
5.6 Would you recommend the Design and Build project delivery option to your current and new clients? Please indicate answers in a priority order.

		High ←						*Low* →
1.	Yes, (Please say why)	1	2	3	4	5	6	7
2.	No, (Please say why)	1	2	3	4	5	6	7
3.	Subject to project complexity	1	2	3	4	5	6	7
4.	Subject to client understanding of fast track and Design and Build process.	1	2	3	4	5	6	7
5.	Only if contractually requested	1	2	3	4	5	6	7
6.	Subject to availability of experienced Design and Build Contractors.	1	2	3	4	5	6	7
7.	Others, (Please specify)	1	2	3	4	5	6	7

5.6.1 Purpose

This question is common to both sample categories. It examines the future expectation and conditions that would influence both the design consultant and contractors decision to adopt D&B project procurement option. The answers are intended to gather additional viewpoints from the industry's key participants concerning D&B projects.

5.6.2 Responses



	Subject to project complexity	Subject to Client understanding of fast track and D/B process	Subject to availability of experienced D/B contractors	Only if contractually requested	Yes	No	Others
Consultants	2.79	2.79	2.89	3.36	3.93	5.21	7
Contractors	3.37	3.49	3.49	3.57	3.8	3.49	6.83

Figure 5.5.6. The Results from Each Group on When to Recommend the D&B Project Delivery Option to Their Current and New Clients.

5.6.3 Comments

With an exception of one category, this attitudinal question received consistent and identical results for all categories from both groups. The opinions of the sample did not vary and a clear majority was obtained on almost all points. Interestingly, there was no straight (Yes) from both groups. This criterion was ranked 6 on a scale of 7 points. Both groups selected the same three most important criteria in the same order of priority. The response from the consultants came as follows:

Subject to project complexity with the highest majority and Mean value of (2.79)

Subject to the Client understanding of D&B process with a Mean value of (2.79). Subject to availability of experienced D&B contractors with a Mean value of (2.89).

Contractors' answers are identical for the first category and Mean value of (3.37) and Mean value of (3.49) for the second and Mean value of (3.49) for the third category.

It is also worth mentioning here that consultants voted with (No) as a last resort. In contrast, contractors selected (No) in the middle choice, ranking fourth on the seven

point scale. These answers reveal an underlying concern for the future of D&B option in the Saudi construction industry. The key participants are indicating that their acceptance to procure D&B projects has conditions including having an educated and experienced clients with the D&B project delivery option. However, the T-Test Levene results show that two categories are giving statistically significant (sig≤.05) results which affect extending the generalization to the total population.

1. The No answer category
2. Subject to availability of D&B contractors category.

5.7 Do you think the Design and Build project delivery option may become a choice for the Saudi construction industry in the future?

CONSULTANTS/ CONTRACTORS

1. ☐ Only after major change in the industry Practice towards collaboration
2. ☐ Only in boom times
3. ☐ No
4. ☐ Depends on the client's Understanding of the D&B option
5. ☐ Yes
6. ☐ Yes, through the public sector
7. ☐ Not sure
8. ☐ Yes, through the private sector
9. ☐ Other (please specify)

5.7.1 Purpose

This question surveys the general opinion of the respondents about the future of D/ B option in light of the previous questions. It will provide the participants the opportunity to express their generic views about the future of D/ B option. Is it here to stay or is it cyclic?

5.7.2 Responses from both groups

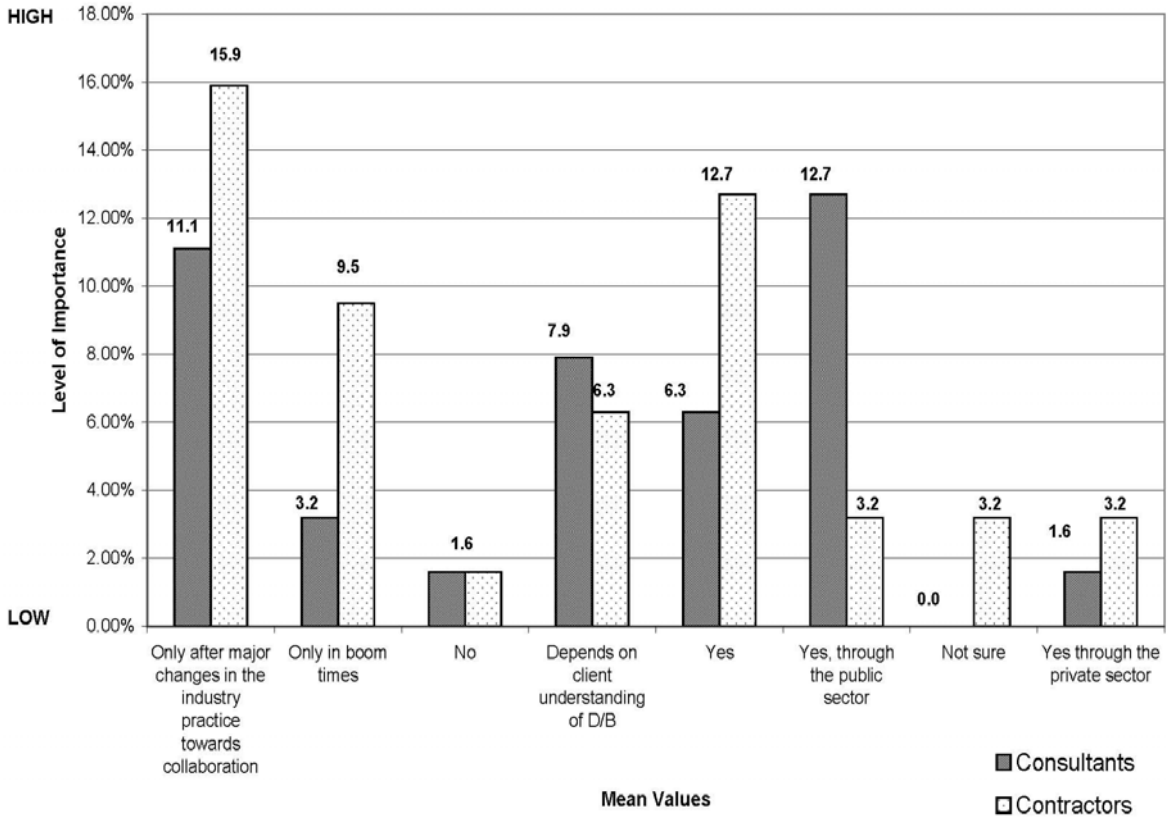


Figure 5.5.7. The Main Findings and the Views of Both Groups Regarding the Future of D&B Project Delivery Option.

5.7.3 Comments

The above attitudinal answers summarized in **Figure 5.5.7** are very much in agreement with the findings of the previous question. The majority of the combined respondents twenty seven percent (27%) answered that D&B option will survive following major changes in the industry towards more collaboration between the key industry stakeholders. The higher ratio of the votes came from the contracting firms. Whereas nineteen percent (19.0%) of the combined answers responded with (Yes) to the continuity and demand for D&B option in the future, respective of the final outcome of D&B. Only fifteen percent (15.9%) answered (Yes) but through the lead of the public sector. The majority of the answers came from the contracting firms. On the other hand, four point eight percent (4.8%) of the sample believes that this project delivery option will survive if private sector takes the lead. Immediately after this criterion came the condition of (Dependant on the clients' understanding with D&B option with over fourteen percent (14.3%) of the responses. It was a surprise to see that less than thirteen percent (12.7%) of the answers believe that D&B option will only continue in boom

times. These results do not give enough confidence that D&B option will continue to be in high demand. This is despite previous answers that expect contractors, investors, government agencies and developers to continue demanding this method of delivery for their projects.

5.4 Analysis of the Direct Semi-Structured Interviews with Seven key Industry Stakeholders.

This section presents the answers that were gained from the direct interviews representing the second source of data received from the semi-structured interviews as documented in **Appendix (B)** and conducted with seven other sectors of the Saudi construction industry. These seven representative sectors are:

1. Public sector clients.
2. Private sector clients.
3. Real estate developers.
4. Government authorities.
5. Manufacturers and Suppliers.
6. Insurance firms.
7. Financial market evaluators.

Following the complete analysis of the semi-structured questionnaire from the seven sectors of the Saudi construction industry stakeholders, the main findings, concepts and themes are identified and divided into three main categories from the answers. These categories represent the respondents that are:

1. In Agreement with D&B option next to D.B.B option
2. In disagreement with D&B option.
3. Undecided or not sure.

The first category includes all answers and comments of those respondents who responded favorably to the D&B option. The second category includes the responses of the other group of the participants who, contrary to the first group, believe that D&B option is not the answer for accelerating the design and construction process. As a result, they disagree with the viability of D&B option. Each category was subsequently coded and subdivided into a number of pertinent sub-categories as detailed in the followings sections.

A total of (40) direct interviews were made with senior members, managers, advisors and executives at ministries, along with public and private clients, real estate developers, investors, market evaluators and insurance firms who are directly involved

with the local construction industry. These participants were either directly involved in processing projects on D&B basis, or have the experience in working within D&B environment, as well as, the traditional option.

Thirty one interviews were conducted on a face to face basis, whilst the other nine were done over the telephone. Both semi-structured and open-ended questions were prepared within five parts which included 35 Thirty Five thematic questions as follows:

The First Part contains general information and project performance questions. This part is applicable to all sectors.

The Second Part includes thematic questions, specific to the Public and Private sectors, Real estate Agencies and Government Authorities sectors.

The Third Part includes thematic questions specific to the Manufacturing and Suppliers sectors.

The Fourth Part includes thematic questions specific to Insurance firms and Financial Market Evaluators sectors.

The Fifth Part contains Open-Ended general question (Applicable to all sectors).

The respondents were asked to express their views and provide answers regarding several key issues which include:

1. What is their knowledge with D&B and D.B.B project procurement options?
2. When selecting D&B option what project procurement model do they follow?
3. Who prepares the RFP scope of work and the contractual arrangements?
4. What are the results of D&B projects in meeting the time, cost and quality targets?
5. Do they use a project procurement selection system?
6. Do they use a prequalification process to select and award D&B projects?
7. What are the regulatory and planning problems that the local authorities face when reviewing and approving D&B projects?
8. Do the D&B projects encounter problems or delays to obtain the building permit and construction approvals?
9. What do they consider as the impediments to the adoption of D&B option?

10. What would make the D&B project delivery option an attractive option for the Saudi construction industry?

Most of the participants held managerial positions. They were given the freedom and flexibility to openly discuss the D&B and traditional path options. The full data received form these interviews are documented in **Appendix (D).**

5.4.1 Summary of the Responses from the Public and Private Sector, Real- Estate Developers and Government Authorities.

All answers were first edited, classified, and then the frequencies of the responses that belonged to each category of questions were statistically calculated, computed and distributed according to the relevant category supported with percentages of the responses. Following the responses, comments regarding these findings are provided.

5.4.1.2 Analysis of the direct interviews with Public Sector Clients

A total of six interviews with representatives of four ministries were made.

These direct interviews were made between January and September 2008 at times appropriate for the respondents. These interviews were conducted following direct visits and consultation with senior managers and executives representing premises and projects departments. These ministries are:

1. Ministry of Interior. (MOI)
2. Ministry of Education. (MOE)
3. Ministry of Finance. (MOF)
4. Ministry of Health. (MOH)

Two direct interviews were made with the MOI projects department. One with the head of contracts department and the other with senior project manager. One interview was made with the director of premises department at the MOE. Two interviews were made with the MOF. One with the assistant general director for projects department. The second with senior engineer in the project management department. One interview was made with the director of projects and maintenance department at the MOH.

Summary of the Results from the Public Sector Participants.

Q. 1	**Practical and personal knowledge about D&B option.**	**Response out of (6)**	**%**
	Aware	5	83
	Not Aware	0	0
	Vaguely Aware	1	17
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Response out of (6)**	**%**
	Aware	5	83
	Not Aware	0	0
	Vaguely Aware	1	17
Q. 3	**Have your D&B projects met their budget targets?**	**Response out of (6)**	**%**
	Yes	2	33
	No	1	17
	Not Always	3	50
Q. 4	**Have your D&B projects met their schedule?**	**Response out of (6)**	**%**
	Yes	2	33
	No	1	17
	Not Always	3	50
Q. 5	**Have your D&B projects achieved their quality standards?**	**Response out of (6)**	**%**
	Yes	3	50
	No	1	17
	Not Always	1	17
Q. 6	**Are you aware of a standard project procurement selection system to choose the optimum project delivery system for D&B projects?**	**Response out of (6)**	**%**
	Yes	2	33
	No	2	33
	Not sure	2	33
Q. 7	**Do you use an industry standard project procurement selection system or model to choose the optimum project delivery system for your projects?**	**Response out of (6)**	**%**
	Yes	2	33
	No	2	33
	Not sure	2	33
Q. 8	**Do you prefer using the D.B.B or the D&B project delivery option and why?**	**Response out of (6)**	**%**
	D&B	(3)	50
	D.B.B	((3))	50
	Speed	(2) ((3))	(83)
	Lower cost	(3)	(50)
	Certainty of price	(2)	(33)
	Better quality	(2) ((1))	(50)
	Due to government contractual laws	(4)	(66)
	Better risk management	(1) ((2))	(50)
	Familiarity with this option	(1) ((4))	(83)
	Certainty of delivery	(1) ((2))	(50)

Q. 9	**Do you use a standard D&B form of contract to procure your D&B projects or develop a bespoke form?**	**Response out of (6)**	**%**
	Use a standard contract form	2	33
	Develop a bespoke form	3	50
	Not sure	1	17

Q. 10	**Who prepares the scope of work for your D&B projects?**	**Response out of (6)**	**%**
	Prepare in- house	2	33
	Out- source to an independent entity	1	17
	Combined effort between in-house and independent entity	3	50
Q. 11	**What process do you follow to select the D&B entity for your D&B projects?**	**Response out of (6)**	**%**
	Two-stage prequalification selection process	2	33
	Lowest offer is awarded the project	2	33
	Select D&B firm based on track record	2	33
Q. 12	**What stage of the project life cycle do you invite the D&B firm to bid for the D&B project?**	**Response out of (6)**	**%**
	Following the preparation of the RFP document	2	33
	Following the preparation of the Feasibility study	1	17
	Following the preparation of the architectural concept design stage	2	33
	Following the preparation of the architectural preliminary design stage	1	17
Q. 13	**Who manages your D&B projects?**	**Response out of (6)**	**%**
	Managed by in-house staff	1	14
	Managed by an architectural/Engineering firm	1	17
	Managed by a project management firm	4	66
Q. 14	**Do you think that D&B project delivery option would become a choice for the Saudi construction industry next to the traditional option in the future?**	**Response out of (6)**	**%**
	Yes	3	50
	No	2	33
	Not sure	1	17
Q. 15	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Response out of (6)**	**%**
	Yes	3	50
	No	1	17
	Not sure	2	33
Q. 16	**Do the D&B projects encounter problems or delays to obtain the planning and building permits approvals?**	**Response out of (6)**	**%**
	Yes	3	50
	No	2	33
	Not sure	1	17
Q. 17	**Do the local municipalities face problems in approving D&B projects during design and/or construction stages?**	**Response out of (6)**	**%**
	Yes during design stages	4	50
	No	2	17

	Yes during construction stages	3	50
	No	3	50
Q. 18	**In your opinion, what are the impediments to the adoption of D&B project delivery option**	**Response out of (6)**	**%**
	Lack of knowledge and understanding with D&B project delivery option.	4	66
	Shortage of capable D&B firms.	4	66
	Cultural barriers and mistrust.	4	66
	Current government contract are oriented towards D.B.B option.	5	83
	Contracting environment is risky and claims' oriented.	4	66
	Lack of local professionals who are experienced with D&B project delivery option.	4	66
	D&B projects are perceived to be risky and do not meet the quality standards.	5	83
Q. 19	**In your opinion, what are the solutions and recommendations to make the D&B project delivery option more attractive to the Saudi construction industry?**	**Response out of (6)**	**%**
	Change the current government contractual laws which are based on the D.B.B option	5	83
	Increase awareness regarding the benefits of the D&B project procurement strategy. There is a need for industry wide research regarding the benefits of D&B contracting.	4	66
	Consulting and contracting firms need to team up on long term basis.	4	66
	The design brief must include sufficient data and information to enable D&B firms to submit a comprehensive and accurate financial offer.	3	50
	The local construction industry needs trained professionals and project management firms who are experienced with D&B procurement option.	4	66
	Transparency in tendering and open accounting will help promote the D&B project delivery option.	4	66
	There are cultural and legal barriers that stand between the clients and the adoption of D&B contracting. These barriers need to be analyzed and removed.	5	83
	There is a need to have medium and small size D&B firms who can handle medium size D&B projects.	3	50

Comments:

The results conform with the literature review and the structured questionnaire survey. The majority of these clients eighty three percent (83%) is aware of the D&B project delivery option and have used it on their projects. Fifty percent of them (50%) stated that their D&B projects met their quality standard, but failed to meet their budget or their schedule. In addition, there is an apparent division between these clients regarding their awareness and use of the project procurement selection system. The answers were equally spread among Yes, No and Not Sure. This division is also apparent in their preference of project procurement strategy they prefer to use to procure their projects. The answers are split equally fifty percent (50%) between the D&B and D.B.B options. The reasons for those clients who prefer the D&B option are: lower cost and better risk management. Those who favor the traditional option think that D.B.B is in compliance with the government laws. Also, they are familiar with this option.

Moreover, the majority of the respondents (50%) stated that they use a bespoke contract to procure their D&B contracts. The same majority indicated that they prepare the scope for the D&B projects with their in-house staff assisted by an independent firm.

Different answers were given to the question of "at what stage the ministry invites D&B entities for D&B projects". The answers were divided between following the preparation of the RFP document and at the preparation of the design concept stage. These replies coincide with the findings of the literature review. The case study confirmed this. There is no barrier to when the clients demand the D&B option. Market conditions, financing pressures and late awareness and knowledge of this technique would explain why the clients select this project delivery option at any design phase respective of the appropriateness of their decisions. About fifty percent (50%) of these respondents confirmed that their D&B projects face delays when approaching the local authorities and also suffer problems during construction.

The main impediments to the adoption of D&B contracting that these client consider are spread among the government contracting procedures, the increased risk associated with D&B projects with eighty three percent (83%) and the lack of knowledge and understanding among the clients with respect to the application and implication of D&B project delivery option. In addition to the need to have more trained and experienced professional involved in D&B projects, the solutions and recommendation that make the D&B option more attractive were mainly:

- Changing the current government contracting regulations which are based on D.B.B
- Removing the cultural barriers and mistrust between clients and contracting firms

All respondents reported impediments to the adoption of D&B option. Nevertheless, they all reported that D&B option will grow and be in demand in the future. They recommended its adoption.

5.4.1.3 Analysis of the Direct Interviews with the Private Sector Clients.

A total of seven interviews with private sector clients were made. Five were direct and two were conducted over the telephone.

Only seven interviews were made at various times based on the appropriate time of the respondents. These interviews were conducted following direct visits and consultation with the respondents. These clients have procured their own projects along the D&B option. The interviews were made with the following clients:

1. Three residential projects owners. (RES)
2. Two commercial projects owners. (COM)
3. Two retail projects owners. (RET).

Three interviews were made with Saudi owners of large residential compounds Saudi owners. One was direct, and two over the phone. Two direct interviews were held with owners of multistory office buildings. Two interviews were made with the owners of shopping malls and shopping center projects.

Summary of the Results from the Private Sector Participants.

Q. 1	**Practical and personal knowledge about D&B option.**	**Response out of (7)**	**%**
	Aware	7	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Response out of (7)**	**%**
	Aware	7	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 3	**Have your D&B projects met their budget targets?**	**Response out of (7)**	**%**

	Yes	3	43
	No	1	14
	Not Always	3	43
Q. 4	**Have your D&B projects met their schedule?**	**Response out of (7)**	**%**
	Yes	3	43
	No	1	14
	Not Always	3	43
Q. 5	**Have your D&B projects achieved their quality standards?**	**Response out of (7)**	**%**
	Yes	5	71
	No	1	14
	Not Always	1	14
Q. 6	**Are you aware of a standard project procurement selection system to choose the optimum project delivery system for D&B projects?**	**Response out of (7)**	**%**
	Yes	2	28
	No	3	43
	Not sure	2	28
Q. 7	**Do you use an industry standard project procurement selection system or model to choose the optimum project delivery system for your projects?**	**Response out of (7)**	**%**
	Yes	1	14
	No	3	43
	Not sure	3	43
Q. 8	**Do you prefer using the D.B.B or the D&B project delivery option and why?**	**Response out of (7)**	**%**
	D&B	(5)	71
	D.B.B	((2))	28
	Speed	(3) ((3))	(86)
	Lower cost	(4)	(57)
	Certainty of price	((2))	(28)
	Better quality	(3) ((3))	(86)
	Due to government contractual laws	(1)	(14)
	Better risk management	(1) ((2))	(43)
	Familiarity with this option	(1) ((3))	(57)
	Certainty of delivery	(4) ((2))	(86)
Q. 9	**Do you use a standard D&B form of contract to procure your D&B projects or develop a bespoke form?**	**Response out of (7)**	**%**
	Use a standard contract form	3	43
	Develop a bespoke form	2	28
	Not sure	2	28
Q. 10	**Who prepares the scope of work for your D&B projects?**	**Response out of (7)**	**%**
	Prepare in- house	1	14
	Out- source to an independent entity	4	57
	Combined effort between in-house and independent entity	2	28
Q. 11	**What process do you follow to select the D&B entity for your D&B projects?**	**Response out of (7)**	**%**

	Two-stage prequalification selection process	2	28
	Lowest offer is awarded the project	2	28
	Select D&B firm based on track record	3	43
Q. 12	**What stage of the Project life cycle do you invite the D&B firm to bid for the D&B project?**	**Response out of (7)**	**%**
	Following the preparation of the RFP document	1	14
	Following the preparation of the Feasibility study	0	0
	Following the preparation of the architectural concept design stage	1	14
	Following the preparation of the architectural preliminary design stage	5	71
Q. 13	**Who manages your D&B projects?**	**Response out of (7)**	**%**
	Managed by in-house staff	1	14
	Managed by an architectural/Engineering firm	5	71
	Managed by a project management firm	1	14
Q. 14	**Do you think that D&B project delivery option would become a choice for the Saudi construction industry next to the traditional option in the future?**	**Response out of (7)**	**%**
	Yes	4	57
	No	2	28
	Not sure	1	14
Q. 15	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Response out of (7)**	**%**
	Yes	3	43
	No	3	43
	Not sure	1	14
Q. 16	**Do the D&B projects encounter problems or delays to obtain the planning and building permits approvals?**	**Response out of (7)**	**%**
	Yes	3	43
	No	2	28
	Not sure	2	28
Q. 17	**Do the local municipalities face problems in approving D&B projects during design and/or construction stages?**	**Response out of (7)**	**%**
	Yes during design stages	4	57
	No	3	43
	Yes during construction stages	3	43
	No	4	57
Q. 18	**In your opinion, what are the impediments to the adoption of D&B project delivery option?**	**Response out of (7)**	**%**
	Lack of knowledge and understanding with D&B project delivery option.	4	57
	There is a shortage of capable D&B firms in the local construction industry market.	4	57
	Contractors are perceived to be making short cuts at the expense of the quality. This perception must be challenged and changed.	4	57
	Current government contracts are oriented towards D.B.B option.	5	71
	D&B projects are considered to be risky and lead to cost	4	57

	overruns.		
	There is a lack of local experienced project management firms and experienced professionals with D&B project delivery option.	4	57
	Many D&B firms prefer working on cost plus basis. This practice is not acceptable to many clients who prefer a lump sum contract.	5	71
Q. 19	**In your opinion, what are the solutions and recommendations to make the D&B project delivery option more attractive to the Saudi construction industry?**	**Response out of (7)**	**%**
	Increase awareness about the benefits of D&B project delivery option.	4	57
	For private projects it is better to have an architect for the concept design and to supervise the production of the developed design.	3	43
	The D&B scope of work and performance specifications must be accurate and complete to avoid unnecessary claims.	3	43
	The local construction industry needs trained professionals and project management firms experienced with D&B procurement option.	4	57
	Building trust and working with GMP arrangements is a step forward to promote the adoption of D&B project delivery option.	4	57
	If the design is novated then the contractor must be invited from the outset to make suggestions regarding alternative construction methods/techniques.	2	28
	Unclear items during tendering stage are better given provisional sums. This will minimize the contingency costs	2	29

Comments:

The majority of these private sector clients confirmed that they are aware of the D&B project delivery option. They use it on their projects. Although only forty three percent (43%) of these respondents stated that D&B option met their cost and schedule targets, the majority seventy one percent (71%) reported that D&B option achieved their quality standards. Surprisingly, and despite the fact that seventy one percent (71%) of these clients prefer the D&B option over the D.B.B option, a majority of eighty six percent (86%) are not aware of an industry project procurement selection model useful for selecting the appropriate project delivery system.

The answers suggest that these clients use D&B for reasons of speed, lower cost, certainty of delivery and better quality. The majority of these clients forty three percent (43%) use a standard D&B contract form to procure their projects. Over fifty seven percent (57%) use an independent entity to prepare the scope of work for them. These

clients, however, are divided on the subject of the selection and the award the D&B entity. The answers were spread equally between lowest cost, using two stage-selection process, and on track record. A majority of fifty seven percent (57%) of these respondents confirmed that their D&B projects face problems when approaching the local authorities to obtain building approval and also suffer problems during construction.

A lack of a clear understanding of the procurement selection criteria was evident. These clients do not follow a specific procurement selection model and rely on their in-house capabilities to choose the project contracting option to follow. The answers also suggest that these private sector clients (71%) prefer to appoint an architectural firm to develop the concept and to manage the D&B process.

Similar to the public sector clients, these clients observe impediments to the adoption of D&B contracting in the current government contacts. The government contracts are based on the traditional option and rooted in the belief that D&B option is risky. Improvement areas were reported in the areas where:

- Increase awareness of the benefits of D&B project procurement strategy.
- The local construction industry needs trained professionals and project management firms experienced with D&B procurement option.
- Transparency in tendering and open accounting will help promote the D&B project delivery option.

The above answers were no surprise to the study. Similar answers were received during the questionnaire survey. It was confirmed that when the D&B option is considered, the delivery of the design package suffered. Drawings are issued late and many times with various errors and missing information. This translates into inherent risk in the process.

All respondents reported valid impediments to the adoption of D&B option. The majority fifty seven percent (57%) reported that D&B option will be in demand in the local Saudi construction industry. However, it is subject to overcoming some cultural and organizational impediments.

5.4.1.4 Analysis of the Direct Interviews with Real- Estate Developers Sector Clients

A total of Four interviews with Real Estate developers sector clients were made. Three were direct and one over the telephone. The interviews were made at various times at the convenience of the respondents. These interviews were conducted following direct

visits and consultation with the respondents. These clients have procured their own projects along the D&B option. The interviews were made with the following clients:

1. Two direct interviews with two managers of one real estate company. (SSG)
2. One over the phone with one real estate company. (Dar J)
3. One direct interview with one real estate company. (D.G)

Summary of the Results from the Real Estate Sector Participants.

Q. 1	**Practical and personal knowledge about D&B option.**	**Response out of (4)**	**%**
	Aware	4	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Response out of (4)**	**%**
	Aware	4	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 3	**Have your D&B projects met their budget targets?**	**Response out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not Always	1	25
Q. 4	**Have your D&B projects met their schedule?**	**Response out of (4)**	**%**
	Yes	2	50
	No	0	0
	Not Always	2	50
Q. 5	**Have your D&B projects achieved their quality standards?**	**Response out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not Always	1	25
Q. 6	**Are you aware of a standard project procurement selection system to choose the optimum project delivery system for D&B projects?**	**Response out of (4)**	**%**
	Yes	2	50
	No	0	0
	Not sure	2	50
Q. 7	**Do you use an industry standard project procurement selection system or model to choose the optimum project delivery system for your projects?**	**Response out of (4)**	**%**
	Yes	1	25
	No	2	50
	Not sure	1	25
Q. 8	**Do you prefer using the D.B.B or the D&B project delivery option and why?**	**Response out of (4)**	**%**

	D&B	(4)	100
	D.B.B	((0))	0
	Speed	(3)	(75)
	Lower cost	(3)	(75)
	Certainty of price	(2)	(50)
	Better quality	(2)	(50)
	Due to government contractual laws	(0)	(0)
	Better risk management	(3)	(75)
	Familiarity with this option	(1)	(25)
	Certainty of delivery	(3)	(75)
Q. 9	**Do you use a standard D&B form of contract to procure your D&B projects or develop a bespoke form?**	**Response out of (4)**	**%**
	Use a standard contract form	2	50
	Develop a bespoke form	1	25
	Not sure	1	25
Q. 10	**Who prepares the scope of work for your D&B projects?**	**Response out of (4)**	**%**
	Prepare in- house	1	25
	Out- source to an independent entity	2	50
	Combined effort between in-house and independent entity	1	25
Q. 11	**What process do you follow to select the D&B entity for your D&B projects?**	**Response out of (4)**	**%**
	Two-stage prequalification selection process	2	50
	Lowest offer is awarded the project	1	25
	Select D&B firm based on track record	1	25
Q. 12	**What stage of the Project life cycle do you invite the D&B firm to bid for the D&B project?**	**Response out of (4)**	**%**
	Following the preparation of the RFP document.	0	0
	Following the preparation of the Feasibility Study.	2	50
	Following the preparation of the architectural concept design stage.	2	50
	Following the preparation of the architectural preliminary design stage.	0	0
Q. 13	**Who manages your D&B projects?**	**Response out of (4)**	**%**
	Managed by in-house staff	0	0
	Managed by an architectural/Engineering firm	2	50
	Managed by a project management firm	2	50
Q. 14	**Do you think that D&B project delivery option would become a choice for the Saudi construction industry next to the traditional option in the future?**	**Response out of (4)**	**%**
	Yes	4	100
	No	0	0
	Not sure	0	0
Q. 15	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Response out of (4)**	**%**
	Yes	4	50
	No	0	0
	Not sure	0	0

Q. 16	**Do the D&B projects encounter problems or delays to obtain the planning and building permits approvals?**	**Response out of (4)**	**%**
	Yes	2	50
	No	2	50
	Not sure	0	0
Q. 17	**Do the local municipalities face problems in approving D&B projects during design and/or construction stages?**	**Response out of (4)**	**%**
	Yes during design stages	3	75
	No	1	25
	Yes during construction stages	3	75
	No	1	25
Q. 18	**In your opinion, what are the impediments to the adoption of D&B project delivery option?**	**Response out of (4)**	**%**
	Lack of knowledge and understanding regarding D&B project procurement strategy option.	2	50
	There is an obvious shortage of capable D&B firms.	3	75
	Many D&B firms fail to produce full decennial insurance coverage.	2	50
	Current government contract are oriented towards D.B.B option. These contracts must be amended.	2	50
	There is an apparent division within the industry separating consulting firms from contracting firms.	2	50
	Lack of local experienced professionals with D&B project delivery option.	3	75
	Not many consulting firms are keen to team up with contracting firms on D&B projects.	2	50
	Many D&B firms do not have the organizational structure to administer, price and implement a D&B project.	2	50
Q. 19	**In your opinion, what are the solutions and recommendations to make the D&B project delivery option more attractive to the Saudi construction industry?**	**Response out of (4)**	**%**
	Increase the public awareness and knowledge regarding the benefits of D&B project delivery option.	3	75
	Contracting firms need to have in-house design capabilities and staff experienced in procuring D&B projects.	2	50
	Selection of a capable D&B firm must be based on value system and not based on low cost which is the current practice.	2	50
	The use of two stage best value prequalification will increase the popularity of the D&B project delivery option and solve the problem of subjectivity.	3	75
	Risk sharing and management is a must in D&B projects.	3	75
	Early completion of D&B projects must be rewarded.	2	50
	Having an independent cost consultant to approve payments and changes in scope will encourage more consulting and contracting firms to adopt D&B projects.	3	75

Comments:

The results support the findings of the literature review and the questionnaire survey. These real estate developers are fully aware of and use D&B to procure their projects. Their reasons include speed of delivery and achieving their financial objectives. These respondents acknowledged that when using D&B option to procure their projects, they did not always meet the project's schedule nor the budget. However, they met the quality standard. They apply a two stage selection process to select and award the D&B entity. They tend to award the D&B projects following either the feasibility study of the project or after the preparation of the architectural concept. They do not follow an established procurement selection model. They choose the appropriate model that suits their projects objectives. Nonetheless, these developers reported that they still face problems in obtaining the design planning and permit approvals from the municipality. They also face problems during construction stages.

They consider the impediments to the adoption of D&B procurement strategy to be:

- The shortage of capable D&B firms within the local construction industry,
- Lack of knowledge regarding this approach, pricing, and procurement of D&B projects,
- The lack of available local experienced professionals who can manage D&B projects.

These developers all confirmed that D&B will be the choice for future projects. They recommend the following improvements that would make D&B option more attractive:

- Increase the public awareness about the benefits of D&B project delivery option. There is a need for an industry wide research about the benefits of D&B contracting.
- The design brief must include sufficient performance specifications and systems requirements data and information to enable D&B firms to submit a comprehensive and accurate financial offer.
- Having an independent cost consultant to approve payments and changes in scope will encourage more consulting and contracting firms to adopt D&B projects.

5.4.1.5 Analysis of the Direct Interviews with Representatives of Government Authorities Sector.

A total of eight interviews with Representatives of Government Authorities Sector were made. Six were direct and Two were conducted over the telephone. The interviews were made at various times based on the availability of the time of the respondents. These interviews were conducted following direct visits and consultation with the respondents. The participants are directly involved with the construction industry, either at tendering, contracting or managing design and construction phases of projects. They had this experience in both D&B procurement strategy and other project delivery options. The interviews were made with the following government agencies:

1. Local Municipality of Riyadh (MOR)
2. Arriyadh Development Authorities (ADA)
3. The General Organization for Social Insurance (GOSI)
4. Saudi Arabian Standards and Organization Authority (SASO)

Two direct interviews were conducted with three members of the local municipality MOR. One with two architects representing the Planning Department and one with the senior architect of the Permits Department.

One direct focus group interview was conducted with two members of the ADA. One member is the assistant head of Planning Department and the other is the assistant head of Construction Departments.

Three interviews were conducted with the Engineering Department of GOSI. Two interviews were conducted with two engineers representing the Engineering department. One interview over the telephone with a project manager representing the site supervision GOSI. Two direct interviews were made with representatives from SASO. One with the head of premises department, and the second with the resident engineer.

Summary of the Results from the Government Authorities Sector Participants

Q. 1	**Practical and personal knowledge about D&B option.**	**Response out of (8)**	**%**
	Aware	5	63
	Not Aware	2	25
	Vaguely Aware	1	12
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Response out of (8)**	**%**

	Aware	5	63
	Not Aware	1	12
	Vaguely Aware	2	25
Q. 3	**Have your D&B projects met their budget targets?**	**Response out of (8)**	**%**
	Yes	2	25
	No	2	25
	Not Always	4	50
Q. 4	**Have your D&B projects met their schedule?**	**Response out of (8)**	**%**
	Yes	2	25
	No	2	25
	Not Always	4	50
Q. 5	**Have your D&B projects achieved their quality standards?**	**Response out of (8)**	**%**
	Yes	3	37
	No	2	25
	Not Always	3	37
Q. 6	**Are you aware of a standard project procurement selection system to choose the optimum project delivery system for D&B projects?**	**Response out of (8)**	**%**
	Yes	1	12
	No	2	25
	Not sure	5	63
Q. 7	**Do you use an industry standard project procurement selection system or model to choose the optimum project delivery system for your projects?**	**Response out of (8)**	**%**
	Yes	2	25
	No	2	25
	Not sure	4	50
Q. 8	**Do you prefer using the D.B.B or the D&B project delivery option and why?**	**Response out of (8)**	**%**
	D&B	(3)	37
	D.B.B	((5))	63
	Speed	(2) ((2))	50
	Lower cost	((4)) (1)	62
	Certainty of price	((4))(2)	75
	Better quality	(2) ((1))	37
	Due to government contractual laws	((6))	75
	Better risk management	(2) ((5))	87
	Familiarity with this option	(2) ((5))	87
	Certainty of delivery	(3) ((3))	75
Q. 9	**Do you use a standard D&B form of contract to procure your D&B projects or develop a bespoke form.**	**Response out of (8)**	**%**
	Use a standard contract form	3	37
	Develop a bespoke form	2	25
	Not sure	3	37
Q. 10	**Who prepares the scope of work for your D&B projects?**	**Response out of (8)**	**%**
	Prepare in- house	2	25

	Out-source to an independent entity	2	25
	Combined effort between in-house and independent entity	4	50
Q. 11	**What process do you follow to select the D&B entity for your D&B projects?**	**Response out of (8)**	**%**
	Two-stage prequalification selection process	2	25
	Lowest offer is awarded the project	3	37
	Select D&B firm based on track record	3	37
Q. 12	**What stage of the Project life cycle do you invite the D&B firm to bid for the D&B project?**	**Response out of (8)**	**%**
	Following the preparation of the RFP document	2	25
	Following the preparation of the Feasibility study	2	25
	Following the preparation of the architectural concept design stage	2	25
	Following the preparation of the architectural preliminary design stage	2	25
Q. 13	**Who manages your D&B projects?**	**Response out of (8)**	**%**
	Managed by in-house staff	3	37
	Managed by an architectural/Engineering firm	3	37
	Managed by a project management firm	2	25
Q. 14	**Do you think that D&B project delivery option would become a choice for the Saudi construction industry next to the traditional option in the future?**	**Response out of (8)**	**%**
	Yes	5	63
	No	1	12
	Not sure	2	25
Q. 15	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Response out of (8)**	**%**
	Yes	5	63
	No	1	12
	Not sure	2	25
Q. 16	**Do the D&B projects encounter problems or delays to obtain the planning and building permits approvals?**	**Response out of (8)**	**%**
	Yes	4	50
	No	2	25
	Not sure	2	25
Q. 17	**Do the local municipalities face problems in approving D&B projects during design and/or construction stages?**	**Response out of (8)**	**%**
	Yes, during design stages	5	63
	No.	3	37
	Yes, during construction stages	4	50
	No.	4	50
Q. 18	**In your opinion, what are the impediments to the adoption of D&B project delivery option?**	**Response out of (8)**	**%**
	Lack of knowledge and understanding regarding the D&B project delivery option.	6	75
	Many D&B firms disband after the completion of a D&B project. Then, when something goes wrong, clients do not know who to contact.	4	50
	D&B contracts may meet the deadline but are expected to	5	63

	produce poor quality standards, and cost overruns.		
	Current design and construction government contracts are oriented towards D.B.B. D&B projects face delays to obtain planning and building permit approvals.	5	63
	D&B projects are too costly when considering design changes that are needed on site. D&B contracts give clients only a short time to review and make decisions.	4	50
	D&B projects require specific skills, and technical requirements for preparing the tender documents, review pricing and managing the construction. These expertise are not commonly available.	4	50
	Many D&B contracting firms do not give a comprehensive decennial insurance.	3	37
	The selection criteria for qualifying and awarding D&B projects are not clear to many local construction industry stakeholders.	3	37
	Not many D&B organizations are well experienced in preparing a convincing D&B tender and bid documents.	4	50
	Many design, procurement, and construction decisions have to be made ahead of time and in the dark. Changes on site may not be possible.	3	37
Q. 19	**In your opinion, what are the solutions and recommendations to make the D&B project delivery option more attractive to the Saudi construction industry?**	**Response out of (8)**	**%**
	Change the current government contractual laws which are based on the D.B.B option.	5	63
	Increase awareness regarding the benefits of D&B project delivery option. There is a need to have a focused research about the benefits of D&B project procurement strategy.	5	63
	There is a need to have medium and small size D&B firms to handle medium size D&B projects.	4	50
	D&B projects are considered unattractive since they deliver lower quality standards. Many problems arise after initial handing over.	3	37
	The local construction industry needs trained professionals and project management firms experienced with D&B procurement option.	5	63
	There are cultural and legal barriers that stand between the clients and the adoption of D&B contracting. These barriers need to be analyzed and removed.	5	62
	There is a need to have a transitional move towards D&B contracting. The industry is not ready for a wholesale move yet.	3	37

Comments:

The results received indicate that government agencies with a majority of seventy five percent (75%) are generally aware of the D&B project delivery option. The majority, however, believe that their D&B projects did not meet the contract schedule, the budget, nor quality standard. The majority of them are not aware of an existing project procurement selection process. Moreover, the majority of sixty two percent (62%) prefer the D.B.B option for reasons of speed, familiarity, and compliance with the government rules. They claim that they face problems with D&B procedures during the design stages when submitting for the building permit and, similarly, during the construction stage.

Some answers confirmed that design quality suffered. Some clients do not work directly with D&B contractor and prefer to appoint a consultant to manage the entire process. Speed of delivery influences the decisions of some agencies. It forced them to adopt D&B option and nothing else. According to the MOR and GOSI the use of D&B project delivery system in Saudi Arabia has more than doubled, compared with the previous decade. The local municipality respondents indicated that they are still developing the rules to properly manage, reviews and permit issuing procedures. They indicated that some of the problems with D&B option are that clients and applicants do not submit sufficient design information for review and expect to have a building permit with little design information.

The ADA uses D&B option comfortably on special projects using the expertise of international consulting firms. The respondents from GOSI and SASO are split regarding the viability of this delivery system as they have experienced some problems using D&B option in their past projects. What came as a surprise is that the majority of these respondents sixty three percent (63%) confirmed that they do not follow a standard construction industry model for selecting the appropriate project procurement system. Rather, they rely on the project management firms to prepare all relevant contractual and management documents.

The impediments to the adoption of D&B are generally lack of knowledge about D&B contracting, availability of experienced local D&B firms, lack of trust between clients and contracting firms. The most important is the lack of knowledge and understanding with D&B project delivery option. Current government contracts are structured to lean

towards D.B.B option. Only sixty two percent (62%) confirmed that D&B will be an acceptable choice for certain future projects.

The suggested areas of improvements that would make this project delivery option more attractive are:

- Change the current government contractual laws which based on the D.B.B option.
- Increase awareness about the benefits of D&B project delivery option. There is a need for an industry wide research about the benefits of D&B contracting.
- The local construction industry needs trained professionals and project management firms experienced with the use of the D&B procurement option.
- There are cultural and legal barriers that stand between the clients and the adoption of D&B contracting. These barriers need to be analyzed and removed.

5.4.1.6 Analysis of the Direct Interviews with Representatives of Manufacturing and Suppliers' Sectors

A total of seven interviews with representatives of the manufacturing sector were made. Six interviews were face to face and one over the telephone. A total of four interviews were conducted with representatives of the suppliers' sector. Three were direct and one was conducted over the telephone. The interviews were made at various times based on the availability of the respondents. These interviews were conducted following direct visits and consultation with these manufacturing and supplier's firms. These companies are providing equipment and pertinent material along the D&B option and other project delivery options. In addition to the general questions in Part One of the questionnaire, the respondents were asked to express their views about six key areas of concern:

1. Do they find D&B projects profitable compared to the D.B.B option?
2. At what stage of the project delivery do they get involved with the D&B projects?
3. Do they require additional fees or costs when procuring D&B projects compared with the D.B.B options?
4. Are they able to deliver D&B projects on time, budget and to the stipulated specifications?

5. What are the main challenges they face when asked to work on D&B projects?
6. What are their views and recommendations for what would make D&B project delivery option an attractive option.

The interviews were made with the following manufacturing and suppliers sector: Respondents from the manufacturing sector.

1. Heating ventilation and air conditioning. (HVAC)
2. Electrical cables, transformers, light fittings, data and low current. (ELEC)
3. Finishes, covering, paint, millwork, metal works, curtain walls. (FINN)
4. Sanitary and kitchenware. (KIT)
5. Cladding materials. (GLZ)

Two interviews were made with two representatives of HVAC firms and two with FINN firms. Only one direct interview was made with the representatives of the remaining trades including one over the telephone with the respondent from the GLZ firm. Similarly, one direct interview was made with each of the four representatives of suppliers' firms including one over the telephone with the respondent from the WPM firm. Respondents from the suppliers' sector.

1. Cement and concrete (CON).
2. Water proofing materials. (WPM)
3. Hardware and accessories. (HW)
4. Stone and marble. (STO)

The Cement and concrete firm covers in situ and pre- cast concrete frames.

Summary of the Results from the Manufacturers and Suppliers Sectors Participants

Q. 1	**Practical and personal knowledge about D&B option.**	**Response out of (11)**	**%**
	Aware.	10	91
	Not aware.	0	0
	Vaguely aware.	1	9
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Response out of 11)**	**%**
	Aware.	11	100
	Not aware.	0	0
	Vaguely aware.	0	0
Q. 3	**Have your D&B projects met their budget targets?**	**Response out of 11)**	**%**
	Yes.	5	45
	No.	2	18

	Not always.	4	36
Q. 4	**Have your D&B projects met their schedule?**	**Response out of 11)**	**%**
	Yes.	5	45
	No.	2	18
	Not always.	4	36
Q. 5	**Have your D&B projects achieved their quality standards?**	**Response out of 11)**	**%**
	Yes.	4	36
	No.	4	36
	Not always.	3	27
Q. 6	**Are you aware of a standard project procurement selection system to choose the optimum project delivery system for D&B projects?**	**Response out of 11)**	**%**
	Yes	3	27
	No	3	27
	Not sure	5	45
Q. 7	**Do they find D&B projects profitable compared to the D.B.B option?**	**Response out of (11)**	**%**
	Yes.	5	45
	No.	3	27
	Not sure.	3	27
Q. 8	**Do you prefer using the D.B.B or the D&B project delivery option and why?**	**Response out of 11)**	**%**
	D&B.	(5)	45
	D.B.B.	((6))	54
	Speed.	(5) ((2))	63
	Lower cost.	(4) ((5))	73
	Certainty of price.	(2))(5)	63
	Better quality.	(2) ((5))	63
	Due to government contractual laws.	((6))	54
	Better risk management.	(1) ((5))	54
	Familiarity with this option.	(2) ((5))	63
	Certainty of delivery.	(3) ((4))	63
Q. 9	**Do you use a standard D&B form of contract to procure your D&B projects or develop a bespoke form?**	**Response out of 11)**	**%**
	Use a standard contract form.	4	36
	Develop a bespoke form.	5	45
	Not sure.	2	18
Q. 10	**At what stage of the D&B project do you get involved?**	**Response out of 11)**	**%**
	At the bidding and tendering stage.	5	45
	Following the preparation of the architectural concept design stage.	3	27
	Immediately after the project is on site.	3	27
Q. 11	**Do you charge additional fees or costs to procure and deliver D&B projects**	**Response out of 11)**	**%**
	Yes.	4	36
	Subject to the available time to delivery.	3	27

	Yes, due to additional coordination and risk factors.	2	18
	No.	2	18
Q. 12	**What are the main challenges that you encounter when working on D&B projects?**	**Response out of 11)**	**%**
	Meeting the contract schedule.	7	63
	Meeting the contract budget.	4	36
	Meeting the contract specifications.	3	27
	Having the approved shop drawings on time.	4	36
	Avoiding rework/changes/modifications.	6	54
	Having an experience client project manager.	5	45
	Avoiding delays in payments.	4	36
	Not having an independent cost engineer on site to approve payments.	4	36
	Having rapid decision-making on design and construction matters.	5	45
Q. 13	**Do you think that D&B project delivery option would become a choice for the Saudi construction industry next to the traditional option in the future?**	**Response out of (11)**	**%**
	Yes.	7	63
	No.	1	9
	Not sure.	3	27
Q. 14	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Response out of 11)**	**%**
	Yes	6	54
	No	2	18
	Not sure	3	27
Q. 15	**In your opinion, what are the impediments to the adoption of D&B project delivery option?**	**Response out of (11)**	**%**
	There is a gap between what the local industry think they know about D&B procurement strategy and the actual practice.	6	54
	There is always less time for design, material procurement and construction.	7	63
	D&B contracts suffer delays and cost overrun due to clients' changes.	4	36
	Not having an independent cost engineer on site to approve payments.	5	45
	Variation and changes to the scope of work are not compensated.	4	36
	Clients and contractors do not issue sufficient design information for competitive pricing.	5	45
	Many D&B contracts ask for unrealistic schedule.	5	45
	Manufacturers end up doing the actual design and installation.	4	36
	Some late changes and modifications are too costly.	5	45
	Many clients ask for extended warranty period and liquidated damages insurance.	5	45
Q. 16	**In your opinion, what are the solutions and recommendations to make the D&B project delivery option more attractive to the Saudi construction industry?**	**Response out of 11)**	**%**
	Modification to the current government contractual laws	5	45

	which are based on the D.B.B option is required.		
	Increase awareness about the benefits of D&B project delivery option. There is a need for an industry wide research about the benefits of D&B contracting.	5	45
	Procurement and site activities must commence, once there is sufficient design and specifications.	4	36
	D&B projects must be based on GMP, agreed schedule of rates, or cost plus basis.	4	36
	There must be an independent cost engineer and site project manager on D&B site.	5	45
	Delay clauses and penalties must be removed from the D&B contracts.	3	37
	Rapid decision making is a must in D&B contracts.	4	36
	Clients must agree to appoint an independent site engineer and cost consultant of site. This is to be considered by all parties to the contract.	4	36

Comments:

The results show that manufacturing and suppliers are well aware of the D&B project delivery option, as indicated by an overwhelming majority. About forty five percent (45%) majority believe that they meet the contract schedule and budget. However, only (36%) can meet the stipulated specifications. Forty five percent majority (45%) stated that they are not aware of an existing project procurement selection process but they find D&B contracting profitable. These sectors are split between those who prefer the D&B option with fort five percent (45%) of the respondents and those who prefer the D.B.B with fifty four percent (54%). Those who prefer the D&B option believe that D&B option offers speed, lower cost, and certainty of delivery. On the other hand, those who prefer the D.B.B option gave reasons associated with lower cost, familiarity with this option and compliance with the government rules. The answers suggest that these sectors become involved with D&B projects at the bidding stage. They ask for additional fees and costs for procuring D&B projects.

They claim that their main challenges with D&B projects are:

- Meeting the scheduled deadline,
- Avoiding rework,
- Not having an experienced client representative on site
- Not having rapid decision making process on site.

The impediments to the adoption of D&B are:

- Being the short time available to delivery.
- The general lack of knowledge about D&B contracting.

- Not having an independent cost engineer on site
- The modifications and variations on site.

Nonetheless, about sixty three percent (63%) of these respondents agreed that D&B will be an acceptable choice for certain projects in the future. A majority of fifty four percent (54%) of the respondents would recommend this project delivery option to their client.

The suggested improvements that would make D&B option more attractive:

- Change the current government contractual laws which are based on the D.B.B option.
- Increase the awareness of the benefits of D&B project delivery option.
- Assignment of an independent cost engineer and site project manager on D&B projects.
- Rapid decision making is a must in D&B contracts. This is to be considered by all parties to the contract.
- Procurement and site activities must commence once there is sufficient design and specifications.

5.4.1.7 Analysis of the Direct Interviews with Representatives of the Insurance Firms and Financial Market Evaluators Sectors

A total of Two interviews with representatives of the two reputable insurance firms sector were made. One was direct with two representatives of the National Insurance Company (NIC) and one over the telephone with a representative of MEDGulf Insurance (MED), the second firm.

1. Company One (NCI)
2. Company Two (MED)

The interviews were made at various times based on the availability of the respondents. These interviews were conducted with senior officers, customer's managers, and advisors. They followed direct visits and consultation with these local insurance firms. These firms are providing insurance coverage policies on a range of project types.

Two interviews with representatives of firms from the financial market evaluation sector were made. One was direct with a focus group comprised of three representatives

from one firm. The other was over the telephone with the second firm. Respondents from the financial market evaluation sector represented two main reputable firms.

1. Company One (BAH)
2. Company Two (ABK/DLT)

In addition to the general questions, partially from the semi-structured questionnaire, these respondents were asked to express their views about six key areas of concern:

1. Are there higher insurance premiums associated with D&B projects compared with the D.B.B projects?
2. Do you encounter additional claims and disputes with D&B projects compared to projects from other delivery options?
3. Do you consider and treat D&B projects to have more risk compared to other project delivery options?
4. Does the selection of D&B project delivery option influence your decision regarding the feasibility of the business case?
5. Do you recommend different or alternative financing strategies for D&B projects?
6. What in your view would make D&B an attractive option?

Summary of the Results from the Insurance and Financial Market Evaluators Firms Participants.

Q. 1	**Practical and personal knowledge about D&B option.**	**Response out of (4)**	**%**
	Aware	4	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Response out of (4)**	**%**
	Aware	4	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 3	**Are you aware of a standard project procurement selection system to choose the optimum project delivery system for D&B projects?**	**Response out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not sure	1	25
Q. 4	**Do you use an industry standard project procurement selection system or model to choose the optimum**	**Response**	**%**

	project delivery system for your projects?	**out of (4)**	
	Yes	2	50
	No	1	25
	Not sure	1	25
Q. 5	**Do you prefer using the D.B.B or the D&B project delivery option and why?**	**Response out of (4)**	**%**
	D&B	(2)	50
	D.B.B	((2))	50
	Speed	(2) ((1))	75
	Lower cost	(2) ((1))	75
	Certainty of price	(1) (2)	75
	Better quality	(1) ((2))	75
	Due to government contractual laws	((2))	50
	Better risk management	(2) ((2))	100
	Familiarity with this option	(2) ((2))	100
	Certainty of delivery	(1) ((1))	50
Q. 6	**Do you use a standard D&B form of contract to procure your D&B projects or develop a bespoke form?**	**Response out of (4)**	**%**
	Use a standard contract form	2	50
	Develop a bespoke form	2	50
	Not sure	0	0
Q. 7	**What process do you follow to select the D&B entity for your D&B projects?**	**Response out of (4)**	**%**
	Two-stage prequalification selection process	2	50
	Lowest offer is awarded the project	1	25
	Select D&B firm based on track record	1	25
Q. 8	**What stage of the Project life cycle do you invite the D&B firm to bid for the D&B project?**	**Response out of (4)**	**%**
	Following the preparation of the RFP document	1	25
	Following the preparation of the Feasibility study	1	25
	Following the preparation of the architectural concept design stage	2	50
	Following the preparation of the architectural preliminary design stage	0	0
Q. 9	**Who manages your D&B projects?**	**Response out of (4)**	**%**
	Managed by in-house staff	1	25
	Managed by an architectural/Engineering firm	2	50
	Managed by a project management firm	1	25

Q. 10	**Do you think that D&B project delivery option would become a choice for the Saudi construction industry next to the traditional option in the future?**	**Response out of (4)**	**%**
	Yes	3	75
	No	0	0
	Not sure	1	25
Q. 11	**Are there any additional inherent disputes, claims, financial, contractual or management problem that you anticipate when dealing with D&B contracting?**	**Response out of (4)**	**%**
	Yes	2	50

	No	1	25
	Not sure	1	25
Q. 12	**Is there a higher insurance premium charge for D&B compared with other project delivery options and why?**	**Response out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not sure	1	25
Q. 13	**Have you encountered more claims, disputes and adversarial accounts related to D&B projects compared to other projects along other delivery option?**	**Response out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not sure	1	25
Q. 14	**Does the choice of project delivery option influence your recommendations for the feasibility of the project business case?**	**Response out of (4)**	**%**
	Yes	3	75
	No	1	25
	Not sure	0	0
Q. 15	**Do you recommend different financing schemes for the traditional project delivery option compared with the D&B option?**	**Response out of (4)**	**%**
	Yes	3	50
	No	0	0
	Not sure	1	25
Q. 16	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Response out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not sure	1	25
Q. 17	**In your opinion, what are the impediments to the adoption of D&B project delivery option?**	**Response out of (4)**	**%**
	There is a lack of knowledge and understanding regarding D&B project delivery option.	3	75
	D&B contracts contain more uncertainties, design and construction risks which many local D&B firms are unable to cope with.	3	75
	Fair contractual and legal modifications are required to remove adversarial clauses from the current contracts. D&B contracting is not institutionalized.	2	50
	D&B contracting environment is perceived to be risky and claim's oriented.	3	75
	There is a lack of know-how in pricing, managing and procuring D&B projects from clients, consulting and contracting firms.	2	50
	Not many D&B organizations are well experienced in preparing a clear and accurate D&B scope of service document. This is a source of dispute.	3	75
	Many clients ask for extended warranty period and decennial insurance coverage which is too costly.	3	75

Q. 18	In your opinion, what are the solutions and recommendations to make the D&B project delivery option more attractive to the Saudi construction industry?	Response out of (4)	%
	Amend the current government contractual laws which are based on the D.B.B option.	2	50
	Increase awareness about the benefits of D&B project delivery option. There is a need to institutionalize D&B project delivery within the local construction industry.	3	75
	D&B entities must share the risks, uncertainties and unknowns in the D&B contract with the Client.	2	50
	D&B entity must give clients longer than usual liability and warranty period.	2	50
	Parties to the contract need to use fair and internationally recognized forms of contracts with defined liabilities, responsibilities, and rights.	3	75
	D&B projects must be based on agreed RFP, scope of services, performance specifications, and schedule of rates. Unknown items shall be given provisional sums or agreed on cost plus basis.	2	50
	Having an independent cost engineer and site project manager on D&B site improves transparency between D&B entity and clients.	2	50
	Insurance policies must match the level of risks, uncertainties and be agreed by the client.	2	50
	Selection of the D&B organization must be based on experience, track record, expertise, reputation and technical abilities.	2	50
	Contractual deadlines must match the level of design information issued, required and the actual construction duration time needed.	2	50

Comments:

The results received from these sectors show that the local insurance firms and real estate financial evaluators are aware of the D&B contracting. They confirmed that there is an increase in the use of D&B contracting option. The answers also indicate that the government agencies ask for the most insurance policies. They are followed by the contractors. Both insurance and financial market evaluation firms are aware of an industry project procurement selection system and they use it on their projects.

These firms are divided between those who prefer procuring their projects on D&B basis and those who prefer D.B.B. They are and equally divided on the use of standard and bespoke D&B contract forms. However, those who prefer D&B believe that it offers speed, lower cost and better risk management. D.B.B supporters consider that this option offers certainty of price, higher quality and better risk management as well. The majority of seventy five percent (75%) follow a two-stage prequalification process to select the D&B entity.

Insurance firms are more cautious with D&B contracts. They ask for a higher premiums compared to other project delivery options. Clients ask D&B entities to submit evidence and certificates proving that all liabilities in the D&B contracts are covered.

In addition, a fifty percent (50%) majority of these firms reported that they encountered problems, claims, disputes when dealing with D&B projects, compared to other project delivery options.

Financial market evaluators also indicated with a majority of seventy five percent (75%) majority that the choice of the project procurement system influences their recommendation and feasibility of the project's business case. They also recommend a different financing scheme for D&B projects compared to the D.B.B projects. The financial evaluator firms do not necessarily mention it in their recommendation as a choice to follow. However, they surely include the time to delivery, market entry, and timing and certainty of delivery as a key factor in their recommendation. Cash flow and cost control are also credible factors in their business case evaluation.

Both sectors recommend the use of D&B project delivery option within the local construction industry. They also outlined impediments to the adoption of the D&B option which included:

- D&B contracts contain more uncertainties, design and construction risks which many local D&B firms are unable to cope with.
- D&B contracting environment is perceived to be risky and claim oriented.
- Not many D&B organizations are well experienced in preparing a clear and accurate D&B scope of service document.
- Many clients ask for extended warranty period and decennial insurance coverage which is too costly.

These respondents confirmed that improvements to the adoption of D&B option are:

- Increase awareness about the benefits of D&B project delivery option. There is a need to institutionalize D&B project delivery option within the local construction industry.
- Better sharing of risk between the D&B entity and the client would also encourage the wider application of this delivery option.
- Parties to the contract need to use fair and internationally recognized forms of contracts with defined boundaries of liabilities, responsibilities, and rights.

These respondents stated that improvements to the adoption of D&B contracting are subject to reporting tangible results regarding better performance and productivity with D&B option.

5.5 Summary of the Main Results of the Direct Open-Ended and Semi-Structured Interviews with Consulting, Contracting Firms and the Seven key Industry Stakeholders.

The analysis of these interviews led to establishing three prime categories from the answers. These categories represent the respondents are:

1. In Agreement with D&B option next to D.B.B option
2. In disagreement with D&B option.
3. Undecided or not sure.

The First Category and its sub-categories include the views of the respondents who perceive D&B option as a valid and successful project delivery option. This category believes that D&B will continue to be a popular choice for the industry in the future.

The Second Category and its sub-categories include the views of the respondents who perceive D&B option as an unsuccessful option it is too risky and should be avoided. This category does not believe that this project delivery option will be a choice for the Saudi construction industry in the future.

The Third Category and its sub-categories include the views of the respondents who are undecided with respect to how they perceive the validity and the future of D&B option project delivery option in Saudi construction industry. Their responses remained neutral.

Their answers were recorded to see the size and proportion of this category of the population sample.

The analysis of these main categories was conducted by computing the frequency of answers that belonged to each sub-category. The total results were statistically calculated along with the distribution of the opinions and views of these respondents on each sub-category. **Tables 5.3, 5.4 and 5.5** respectively present the analysis of the results belonging to each category.

This is followed by **Table 5.6** which provides a summary of all the answers for each category with their relevant magnitude and percentages.

Table 5.3. Results of the Direct, Face to Face, Semi-Structured Interviews. Categories of the Respondents Who are in Agreement with D&B Project Delivery Option.

I -In agreement with D&B success and future

- ***Sub-Category 1. Local Knowledge with D&B option and Market acceptability / condition***

a. D&B project delivery is becoming more popular because of its inherent advantages for shortening the project time and reducing cost.
b. Large organizations and contracting firms know how to apply this project delivery option effectively. They prepare the project's scope of work with the appointed project management firm.
c. Local industry uses available forms of contracts to procure D&B projects.
d. International project management and consulting firms practicing in Saudi construction industry are procuring many projects using the D&B option.
e. Tendering for D&B projects is based on best value and not lowest price.
f. The local construction industry is using a standard form of contract but they also use their bespoke project delivery selection process for choosing the optimum project delivery option.

- ***Sub-Category 2. D&B option saves time, by achieving early start and early completion.***

a. D&B option allows for the start of construction following the agreement on the preliminary design phase.
b. Design, construction and procurement teams are working together to solve problems as they arise, procure long lead items and material ahead of time to avoid delays.
c. Encourages off-site work, and designing with the construction process in mind.
d. D&B project delivery option offers value for money.

- ***Sub-Category 3. D&B option is cost effective. Can save cost.***

a. Concurrent design based on experience saves time and cost in design and construction. The focus is on the essentials only.
b. Design is one step ahead of construction. Design is packaged to suit site conditions and schedule.
c. Encourages proactive thinking, saves time and cost, and reduces the number and sequence of work activities.

d. Eliminates waste in tendering time and managing two contracts in many cases.
e. All resources are applied effectively with fewer claims and fewer disputes.
f. Curbs inflation, and escalation of material and equipment prices.
g. All team members are empowered to manage their own problems. D&B team is continually making a trade off between time and cost.
h. All long lead items, material, and equipment are ordered ahead of time to avoid inflation and escalation in prices.

- ***Sub-Category 4. D&B option ensures continuity of work, profitable, promotes better risk management***

a. Earlier project completion means more work for the D&B entity and for the supply chain.
b. Better management of resources.

c. Design and construction risks are with the D&B entity. All other risks are shared and given to the party best capable of handling them.
d. D&B option offers high potential for growth and development.

e. Promotes the establishment of strategic alliances.

f. Better procedures for risk and profit sharing will certainly increase D&B popularity.

- ***Sub-Category 5. D&B option delivers quality work with innovation.***

a. Promotes innovation by conducting design competitions and encouraging creativity in design and construction.
b. D&B entities design to meet performance specifications which are stricter than prescriptive specifications.
c. D&B entity is motivated to innovate in selecting the best quality for the best price and to share a percentage in savings.
d. Contractors and consultants are working together the beginning of the project to achieve the optimum solutions. Contractors can enhance the buildability and constructability of complex projects.

- ***Sub-Category 6. D&B option fosters participative work environment. Win-Win for all parties. Establishes long term relationships.***

a. Clients and D&B entity share losses and profits.
b. All parties share the same vision and objectives of the project.
c. Can help in creating long term and partnering relationships.
d. Work on site can start even if the contractual agreements are not completed yet.
e. Cultural barriers between clients and contractors can be removed.
f. Open book accounting between clients and D&B entities removes many barriers between the parties to the contract.
g. D&B creates participative working environment and team spirit.
h. Instant results are achieved which are rewarding for all parties.
i. Design work is audited and reviewed at the source, simultaneously. Value engineering procedure is kept alive.

- ***Sub-Category 7. D&B option is essential to certain rush and complex projects.***

a. For certain public sector projects, time becomes highest priority.
b. Ideal for complex and sophisticated projects requiring long period of time to complete.
c. Essential for religious, medical and defense projects.
d. Current contractual documents can be adjusted to allow for D&B bidding options.
e. More awareness can be achieved by conducting conferences, seminars and exhibitions to increase the awareness of D&B project procurement option.

- ***Sub-Category 8. D&B project approach can validate the business case and feasibility of critical projects.***

a. Time to start and to complete a project impacts the feasibility of many projects.
b. D&B option creates a sense of urgency and certainty of delivery. It allows for phased occupancy for financially critical projects.
c. Financial and funding strategy for large projects influences the selection of D&B project delivery option.
d. Decennial insurance issues can be resolved between the consulting and contracting firms.

Table 5.4. Results of the Direct, Face to Face, Semi-Structured Interviews. Categories of the Respondents Who are in Disagreement with D&B Project Delivery Option.

II -In disagreement with D&B success and future

- ***Sub-Category 1. Local Knowledge and Market acceptability / condition***

a. D&B option is still a mystery to many clients, consultants and contractors. D&B option is unpopular since many clients do not understand how it works. Clients are confused between D&B and the traditional path with an accelerated program.
b. Contractual procedures, organizational arrangements and duties for each party to the contract are not clear.
c. There are not many D&B entities to procure small and medium size projects. Only few large contracting firms use this project delivery system.
d. D&B project delivery option requires the involvement of an international contracting firm and/or project management firm to manage the project.
e. The Saudi construction industry is more familiar with D.B.B.
f. There are cultural, legal and political reasons against D&B option.

- ***Sub-Category 2. Saves time, achieves early start and early completion***

a. D&B projects go through too many changes and modifications which require additional time.
b. Preparing the project's scope, conducting the prequalification stages and organizing the design competition and tendering phases takes a substantial amount of time.
c. The end result does not yield optimum solutions and in many cases rework is inevitable.
d. D&B option requires too many layers of quality and coordination teams to control quality. This becomes costly and time consuming.
e. Long lead items are never released in time, rework is inevitable. This leads to additional costs and time.

- ***Sub-Category 3 Cost Effectiveness. Can save cost.***

a. The quantity surveyor is last in line. He is required to make assumptions regarding the specifications and quantities since there is no detailed specification and bills of quantities book.
b. Most materials and equipment are ordered ahead of time and in larger quantities than needed for fear of delays and unknowns. This results in waste.
c. Requires the appointment of project management firms to prepare the scope, manage the design and construction phases.
d. The agreed GMP is never met and the final cost is always higher than the agreed GMP sum.

- ***Sub-Category 4. Continuity of Work, profitable Better risk management***

a. Clients refuse to compensate the D&B firm for their misjudgment and wrong estimation.
b. Always planning and re-planning to cover for uncertainties and the unknowns.
c. There is an obvious lack of trust between clients/consultants and contractors. Clients do not feel comfortable leaving the design in the hands of the contracting firm.
d. There is always a risk of misinterpreting the client's RFP and scope of work.This translates into many claims, variation orders, disputes,

and rework.
e. Clients set unrealistic time targets which lead to litigious relationships.
f. Perceived by local industry stakeholders as too risky and litigious.

- ***Sub-Category 5. Achieves quality work with innovation.***

a. Time becomes highest priority. It puts schedule ahead of quality and cost.
b. No creativity, lacks aesthetics. Buildability and repetition is more important than innovative design and fitness for purpose.
c. Subcontractors end up accomplishing most of the design work. They steer the design to suit their products.
d. D&B produces less of everything.
e. Too many site queries which cause the design team to loose focus on the design.
g. Site activities take priority over design activities. QA/QC takes a low priority.

- ***Sub-Category 6. Effective work environment. Win-Win for all parties. Establishes long term relationships.***

a. Consultants do not accept working for contractors.
b. Too many unknowns at tendering stages lead to disputes and adversarial relationship.
c. When something goes wrong on site, who is to blame?
d. The supply chain is squeezed for time and they end up compromising quality.
e. Many D&B firms mislead clients into D&B option to win the project and then claim for changes in scope. Problems are then solved with claims.

- ***Sub-Category 7. Essential to certain rush and complex projects***

a.Rush projects can be procured as fast with D.B.B if proper planning is considered from the outset.
b.Complex and sophisticated projects requiring long period of time to complete can be procured by any project delivery system or by accelerating the D.B.B. These projects can not be taken hostage by D&B option
c. Only special sensitive religious, medical and defense projects can be procured by D&B option.
d. Current contractual documents are geared towards D.B.B options.
e. Increasing public awareness about D&B option requires tangible results.

- ***Sub-Category 8. D&B project approach can validate the business case and feasibility of critical projects***

a. It is the duty of every contractor and consultant to meet or improve the planned schedule.
b. The feasibility of the project can influence the procurement system, but also meeting the deadlines is more important for the business case.
c. Insurance and legal liability terms for design and contracting firms working on D&B contract are not resolved yet.
d. Current contract and legal system is very familiar with D.B.B option projects.

Table 5.5. Results of the Direct, Face to Face, Semi-Structured Interviews. Categories of the Respondents Who are Undecided and Neutral Regarding the Use of the D&B Project Delivery Option.

III –Neutral about the validity of D&B option and future application.

- ***Sub-Category 1. Local Knowledge and Market acceptability / condition.***

  a. D&B project delivery option is new to the local working environment. Knowledge and education about this project delivery option is required.
  b. Not certain about how D&B option works.
  c. Not confident that D&B option is a valid choice to deliver projects.

- ***Sub-Category 2. Saves time, achieves early start and early completion.***

  a. There are good and bad examples of D&B projects that met and did not meet the target date, budget and quality standard.

- ***Sub-Category 3. Cost Effectiveness. Can save cost.***

  a. Not aware of D&B projects that were completed with less than the original budget.
  b. If cheaper projects yield lower quality projects, then where is the saving?
  c. D&B professional staff is highly paid and not available in large numbers.

- ***Sub-Category 4. Continuity of Work, profitable, better risk management***

  a. Not sure that D&B option generates more work, except for public sector clients.
  b. D.B.B option can create the same work relationship between the parties to the contract if all parties to the contract understand their duties and rights.
  c. Risk management is a matter of a contractual agreement, not a choice of a particular project procurement system alone.

- ***Sub-Category 5. Achieves quality work with innovation.***

  a. If the D.B.B option is more acceptable for many clients compared with D&B option, how can the new D&B option achieve better quality in design and construction.
  b. There is a need for successfully completed D&B projects of different types and sizes to gain confidence about this option.
  c. If the quality of the design and construction is not controlled, poor results are inevitable regardless of the project delivery choice.

- ***Sub-Category 6. Effective work environment. Win-Win for all parties. Establishes long term relationships.***

  a. Clients are confused between D&B and the accelerated traditional path.
  b. Not sure how lines of responsibilities between designers and contractors are defined in a D&B option.
  c. Not aware of a clear contract document that defines the roles of the client, consultant and contractor working on D&B project.

- ***Sub-Category 7. Essential to certain rush and complex projects***

  a. Not sure that D&B option is the answer for all rushed and complex projects.

- ***Sub-Category 8. D&B project approach can validate the business case and feasibility of critical projects.***

  a. Reasons for adversarial relationship are not directly related to the choice of project delivery option.
  b. Claims, variation orders, and disputes can be expected under D&B and as well as, other project delivery option.

The following **table 5.5** summarizes all the results of the semi-structured interviews for the three categories and their sub-categories.

Table 5.5 Summary of all the Results of the Semi-Structured Interviews for the Three Categories and their Sub-Categories.

Sub-Category 1. Local knowledge with D&B option and market acceptability / condition	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. The local Saudi construction industry participants are aware of the D&B project delivery option and its inherent advantages for shortening the project time and reducing cost.	40	28	70	8	20	4	10
B. Many public and private sector institutes/ clients prefer to procure their rushed, complex and special projects along the D&B project delivery option.	28	19	67.8	3	10.7	6	21.4
C. The local construction industry uses the best value approach and not the lowest price for tendering and awarding the D&B projects.	27	13	48.1	9	33.3	5	18.5
D. The local construction industry is dominated by the traditional project delivery option. The reason is mainly because many stakeholders are more familiar with this project delivery option.	28	18	64.3	6	21.4	4	14.3
E. Current building permits and building regulations allow for procuring D&B projects. Not all D&B entities comply with the building permit submission requirements for granting approvals.	22	15	68.2	7	31.8	-	-
Sub-Category 2. D&B option saves time achieves early start and early completion.	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. D&B option allows for the start of construction following the agreement on the preliminary design phase.	30	20	66.7	7	23	3	10
B. D&B project delivery option achieves earlier completion of projects.	33	21	63.6	6	18.2	6	18.2
C. Design, construction and procurement teams are working together to solve problems as they arise. This saves design and construction time.	25	16	64	3	12	6	24
D. Encourages off-site work, and designing with construction in mind.	33	23	69.7	2	6.06	8	24.24
E. Offers value for money.	20	11	55	4	20	5	25

Sub-Category 3. D&B option is cost effectiveness. Can save cost.	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. Concurrent design and construction saves time and cost. The design focuses on the essentials only.	22	11	50	5	22.7	6	27.3
B. Design is one step ahead of construction. Design is packaged to suit site conditions and budget. Long lead items and equipment are ordered in time.	23	14	60.8	2	8.7	7	30.4
C. Encourages proactive thinking and value engineering to reduce time and cost.	22	15	68.2	3	13.6	4	18.2
D. Eliminates costs of tendering and managing two contracts in many cases.	22	16	72.7	4	18.2	2	9.1
E. D&B projects meet the project budget. All resources are applied effectively.	29	15	52	5	17	9	31
F. Curbs inflation and escalation of material and equipment prices.	21	16	76.2	-	-	5	23.8
G. All team members are empowered to manage their own problems. D&B team is continually making a trade off between time and cost.	24	15	62.5	3	12.5	6	25
Sub-Category 4. D&B option ensures continuity of Work, profitable and better risk management.	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. Earlier project completion means more business for the clients, D&B entity and supply chain.	24	18	75	2	8.3	4	16.7
B. Better management of resources. D&B leads to fewer claims and less disputes.	26	16	61	5	19	5	19
C. Design and construction risks are with the D&B entity. All other risks are shared and given to the party best capable of handling them.	21	15	71.4	4	19	2	9.5
D. D&B option offers high potential for profitable growth and development.	18	16	88.9	-	-	2	11.1
E. Promotes establishing strategic alliances on long term basis.	23	17	73.9	-	-	6	26.1
F. Better procedures for risk and profit sharing which increase D&B profitability.	25	18	72	4	16	3	12

Sub-Category 5. D&B option delivers quality work with innovation.	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. D&B option promotes innovation by conducting design competitions and encouraging creativity in design and construction.	33	17	51	13	40	3	13
B. D&B entities deliver the project to meet performance specifications which are stricter than prescriptive specifications.	22	15	68.2	2	9.1	5	22.7
C. D&B entity is motivated to innovate in obtaining the best quality for the best price and to share a percentage in savings.	21	15	71.4	-	-	6	28.6
D. D&B projects can achieve the quality standards of design and construction works.	29	16	55.2	6	20.7	7	24.1
E. Contractors and consultants are working together from day one to achieve the optimum solutions.	22	16	72.7	-	-	6	27.3
F. Having the contractors on the project from the outset can enhance the buildability and constructability of complex projects.	26	20	76.9	2	7.7	3	11.5
Sub-Category 6. D&B option fosters participative work environment. Win-Win for all parties. Establishes long term relationships.	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. Clients and D&B entity have participative relationships. They share losses and profits. This leads to less disputes and adversarial relationships.	22	13	59	6	27	3	13.6
B. All parties share the same vision and objectives of the project. D&B allows for earlier start of bidding and contracting based on transparency between clients and D&B entities.	21	14	66.7	4	19	3	14.3
C. Can help in creating long term and partnering relationships.	27	19	70	5	18	3	11
D. Wok on site can start even if the contractual agreements are not completed yet.	29	21	72	6	21	2	6.9

E. D&B option promotes open book accounting between clients and D&B entities which removes many barriers between the parties to the contract and keeps the value engineering procedures alive.	22	16	72.7	4	18.2	2	9.1
Sub-Category 7. D&B option is essential for certain rush and complex projects.	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. D&B is essential for certain public sector projects where time is of the highest priority.	23	15	65	3	13	3	13
B. Ideal for complex and sophisticated projects requiring a long period of time to complete. Long lead items and material are delivered after the concept design is completed.	34	29	85.3	2	5.9	3	8.8
C. Essential for religious, medical, special and large defense and infrastructure projects.	25	18	72	-	-	7	28
D. D&B option is ideal for low budget and tight schedule projects.	29	17	58.6	6	20.7	6	20.7
Sub-Category 8. D&B project approach can validate the business case and feasibility of critical projects	**No. of respondents**	**Yes**	**%**	**No**	**%**	**Not sure**	**%**
A. Time to start and to complete a project impacts the feasibility of many projects.	19	16	84	2	10	3	16
B. D&B option creates a sense of urgency and certainty of delivery.	20	15	75	5	25	-	-
C. It allows phased occupancy for financially critical, and public sector projects.	16	12	75	-	-	4	25
D. Financial and funding strategy for large projects influences the selection of D&B project delivery option.	8	6	75	1	12	1	12
E. Insurance policies for D&B projects cost more than insurance policies for other non D&B procured projects.	20	15	75	-	-	4	20
F. Insurance firms deal with more claims for D&B projects than any other project delivery option	12	8	66.7	-	-	4	33.3
G. Insurance liabilities and decennial insurance coverage are defined and shared between all parties.	8	4	50	2	25	2	25

5.6 Summary

In this chapter, we presented the answers to the analysis of the structured, the semi-structured and the open ended questionnaires.

The findings of the structured questionnaires indicated that this project delivery option has been used by seventy four percent (74.1%) of the consulting and contracting firms for more than 15 years. This suggests that the application of D&B option coincided with the boom times in the 1980's when sizeable government projects occurred and when the private sector invested substantial funds in the real estate. The results showed that local consulting and contracting firms are equally involved with medium and large size D&B projects for more than two decades. For consulting firms, contractors, government authorities, and developers are their main clients that ask for D&B projects. Whereas, contractors reported that investors, private sector clients and government authorities are their main D&B clients. The results also revealed that various local construction clients approach consulting and contracting firms to procure D&B projects following either when the project's RFP document is ready or after they finish the feasibility study for their projects.

Consulting and contracting firms agreed with over eighty five percent (85%) majority that they faced problems when procuring D&B projects. Only thirty two percent (32%) of the consultants believe that their clients are fairly aware of the D&B accelerated program. Contractors, on the other hand, answered with a majority of over sixty five percent (65.6%) that their clients are vaguely aware of the D&B accelerated program. About nine percent (8.6%) of them believe that their clients are fairly aware of D&B option. Similar results were noticed between consultants and contractors regarding the level of their clients' awareness in the industry regarding the expected design changes and their impact on the time and cost of the project. About fifty percent (50%) of the consultants and forty two percent (42.8%) of the contractors believe that their clients are aware of these potential changes.

Consultants reported that the main reasons clients choose to procure D&B projects were speed, dealing with one entity, and cost reduction. Whereas contractors identified reduced cost as their first reason followed by market advantage and earlier receipt of income. This explains why certain clients approach design firms and not contractors to procure D&B projects.

The answers for the nature of impediments to the application of D&B were almost identical for both groups. Lack of general knowledge regarding D&B projects, current contractual environment and the use of D.B.B by the public sector, as well as, cultural and regulatory reasons were the reported impediments for the adoption of D&B procurement.

The answers for what would make consultants and contractors embark on D&B contracting were different for each group. For the consultants, the selection of the contractor, knowledge of the client and clear scope definition were most important. Contractors' answers gave priority to knowledge of the client and followed by selection of the designer and agreeing on contract conditions. Again, these answers highlight the issue of trust based on knowing the client and the D&B partner. The results show that the main problems that consultants and contractors face with D&B projects are different. Consultants face problems due to a lack of trained professionals, financial compensation, and maintaining an acceptable quality standard for the design. Contractors, however, reported a lack of trained resources, absence of fair contractual contracts, delays in issuing shop drawings, delays in approving the procurement schedule for material and equipment, and the necessity of rework as being the main problems. Both groups agree that the lack of trained resources is a common problem. Contractors are not able to discuss the RFP in details with the client. This could be related to having a supervising project management team that stands between the D&B entity and the client.

The answers for what makes the D.B.B option an attractive option were different for both groups. Consultants referred to the clarity of the contract terms, familiarity with this option, and the clarity of the design brief.

Contractors felt that D.B.B is more attractive for the consultants because they prefer not to work with contractors, D.B.B carries less coordination efforts and the scarcity of practicing D&B firms. These answers reveal the impact of the cultural and political barriers working against the application of D&B option. The answers show different responses from each group to the question regarding what would make the D&B option more attractive and help resolve some D&B problems. Consulting firms believe that having an in-house expertise with D&B procurement, a shared understanding of the scope, and an agreement on contractual terms would make the D&B option more attractive.

Contractors, on the other hand, consider having a shared understanding of the scope, and working to an acceptable schedule would make this delivery option more attractive. Again, the answers show the importance of expertise, clarity of scope, and proper contract terms as important issues. The responses regarding the future outlook of D&B option showed that D&B will become a choice of the industry. About nineteen percent majority (19%) and twenty seven (27%) believe this will happen following major changes to the operating climate.

The analysis of the semi-structured questions revealed that the public sector clients are generally aware of the D&B option. The results indicated that this sector is equally split between those who support D&B and those who do not. The answers did not suggest that these clients follow a model for the selection of the optimum project procurement option. However, they consider the use of the current government contracts which are based on the D.B.B option, lack of enough knowledge and experience about D&B, absence of many medium size D&B entities, and the presence of restrictive contractual terms as the main impediments to the adoption of the D&B option. To make D&B an attractive option, improvements to these impediments are required.

Private sector clients are also aware about D&B option and use it to procure their projects. The answers showed that the majority of these clients do not follow a specific project procurement selection model for choosing the D&B option. The answers indicated that these clients use D&B for reasons of speed, lower cost, certainty of delivery and better quality. The majority of these clients use a standard D&B contract form to procure their projects and use an independent entity to prepare the scope of work. A lack of clear understanding of the procurement selection criteria was evident. The answers also suggest these private sector clients prefer to appoint an architectural firm to develop the concept and to manage the D&B process. Similar to the public sector clients, these clients observe impediments to the adoption of D&B contracting in the current use of the government contacts. Improvement in the public awareness regarding the benefits of D&B project delivery option is proposed by them. Transparency in tendering and open accounting will help promote the D&B option.

Developers were found to be more conversant with the D&B option. They use this option more frequently for reasons of speed, economy, and better project quality. The developers consider the impediments to the adoption of D&B as being the shortage of capable D&B firms within the local construction industry, the lack of knowledge regarding D&B option, procurement of D&B projects, and the lack of available local experienced professionals who can manage D&B projects. These developers confirmed that D&B will be the choice for future projects. They recommend two main improvements that would make D&B option more attractive:

- The design brief must include sufficient performance specifications and systems requirements data and information
- Having an independent cost consultant to approve payments and changes in scope will encourage more consulting and contracting firms to adopt D&B projects.

Conflicting responses were received from the government authorities. The majority are aware of the D&B option. They indicated that some of the problems with D&B option are that clients and consultants do not submit sufficient design information to warrant proper review of drawings. The ADA on the other hand, has been using this option successfully for some time. Other authorities (GOSI) and (SASO) are split between those who are applying it with confidence and those who apply it due to market conditions. The majority of these respondents however, claim that they face problems with D&B procedures when submitting for the building permit. Some answers from these authorities confirmed that the design quality of their D&B project suffered. These authorities do not prefer to work directly with D&B contractor. Speed of delivery influences the decisions of some agencies and forced them to adopt D&B option and nothing else.

The manufacturing and suppliers sectors are aware of the D&B option but were also divided between those who are receptive to the D&B option and those who suffered dearly with it. Some manufacturers and suppliers perceive D&B option as a positive choice for their business. It brings them to the project from the outset when they can influence the design and construction. Others suffered losses with D&B due to many changes that occurred following the ordering of the material and equipment. They would not get involved again unless the terms are based on an applied re-measured

contract. These respondents criticized the client's role in creating barriers for advancing and promoting D&B options. Setting unrealistic targets, and not meeting their new contractual obligations. One manager said:

> *"Client demand results instantly without appreciating the additional cost of this delivery option. They believe that consultants should offer D&B delivery option as the first choice. Some D&B firms offer this approach to clients as a marketing tool only, and to win the job without actually completing the job earlier and cheaper"*

They reported that the impediments to the adoption of D&B as being the shortage of capable D&B firms within the local construction industry, lack of knowledge regarding this approach, pricing, and procurement of D&B projects, and the lack of available local experienced professionals who can manage D&B projects. They suggested areas of improvements:

- Change the current government contractual laws to promote D&B option.
- Increase awareness about the benefits of D&B project delivery option. There is a need for an industry wide research regarding the benefits of D&B contracting.
- Cultural and legal barriers that stand between the clients and the adoption of D&B contracting need to be analyzed and removed.

The insurance and financial market evaluation firms confirmed their knowledge of the D&B option. They also reported an increase in the use of D&B option. Insurance firms indicated that they are more conservative and cautious with D&B projects. Higher premiums are charged compared to other projects. These firms consider D&B option to be more risky and D&B entities ask for additional warranties compared to other project delivery options.

Finally, the real estate financial evaluators also confirmed their awareness with D&B option and its potential to accelerate the delivery of the project. However, the respondents argued that meeting the schedule and budget are critical to the success of the business plan regardless of the project delivery that the client chooses to follow. Certainty of delivery and the control of construction risks are areas of concern influencing their recommendation.

The results indicate that the local construction industry is still undecided whether they should or should not embark on this project delivery option. Lack of knowledge with D&B option is apparent. Contractors, clients and consultants are divided. The role of the government in educating the industry and spreading the necessary knowledge was mentioned as an area where more effort is needed. The main improvement is the need to bring consultants, contractors, product manufacturers, material suppliers and fabricators together. The synergies created and the competitive impetus and risk/award sharing will create a more collaborative work environment that is dynamic and oriented towards better performance and continuous improvement. The sample proposed the following improvements:

1. Increasing the public awareness about D&B option through organizing conferences, seminars, and explaining the integrated D&B option.
2. Providing a procedure or a working model to assist clients in choosing the optimum project procurement system that is most appropriate for them to meet their objectives.
3. Having a clear scope of work and performance specifications with fair contractual clauses that define the responsibilities, rights, and duties of each party.
4. The use of best value criteria for selecting and awarding D&B contracts other than low cost. Change the current low cost selection criteria.
5. Encouraging the formation of D&B entities joined on a long term basis through partnering relationships and creating strategic alliances with the supply chain
6. Work collectively on removing cultural barriers between clients and contractors.
7. Modifying the current government contracts which are written according to the traditional option and recognizing the need for the local authorities to develop approval and permit procedures that facilitate the phased construction.
8. Assign an independent cost engineer to review the progress of work and prepare the progress payments.
9. Better risk sharing instead of shifting all risks to the D&B entity.
10. Setting realistic schedule and rewarding early completion.

Based of the above analysis the findings suggested eight main categories where proponent and opponents to the adoption of D&B option critique this project delivery option:

Sub-Category One, Local Knowledge with D&B Option, Market Acceptability and Condition.

Over seventy percent (70%) of the answers confirmed that the Saudi construction industry lacks the true understanding of the D&B options, principles of D&B contracting, procedures, and application. These respondents argued that D&B option will be used only by large organizations who prepare accurate RFP, scope criteria and performance specifications. Their opinion is that D&B entities must have trained professional staff with experience in procuring D&B projects. D&B contracting is not only valid for sudden emergency, repairs, defense projects and the like. Some opposing views consider that the local industry is not ready. They believe that the local market is not ready for coping with D&B option because there are no clear laws, rules and regulations that define its applications. One manager stated:

> *"This lack of knowledge about design and build technique includes the government authorities. Building permits and other approvals take longer time than necessary. The government planners and inspectors are still learning about this option"*

Sub-Category Two, D&B Option Saves Time and Achieves Early Start and Completion,

This category received much support. The majority of the responses voted that D&B option allows for the start of construction following the agreement on the preliminary design phase. Design, construction, and procurement teams are working together to solve problems as they arise. They procure long lead items and material ahead of time to avoid delays. Opposing views state that D&B leads to variation and claims and rework which is costly.

Sub-Category Three, D&B is Cost Effective.

Sixty percent (60%) of this group believe that D&B is an effective method and, if properly applied, can potentially save time. They stated that D&B option makes the D&B firm proactive and focuses on the essentials. As a result, waste and slack time are eliminated. All design items are equally important and treated as a priority. Other opposing views stated that, with D&B option, many decisions are made in the dark, with high probability of guesswork in estimation and planning of resources. Consequently, the project schedule is never accurate. Assumptions are continuously changing and these lead to change. Change, in construction, means additional costs. One engineer said:

> *"Total cost on a fast tracked project is expected to spiral and many projects have unjustified wasted spaces in them".*

To these managers, D&B option breeds claims variation orders, disputes and litigious relationships. D&B clients discover near project completion that what they wanted is more expensive than they thought.

Sub-Category Four, The Continuity of Work and Profitability.

The answers were very positive. D&B option for them is an indication that they are more competent. Clients would favor them over other consultants. One of the managers stated:

> *"D&B option means better resources management and an efficient use of the firm's resources. In a highly volatile market, the early completion of work benefited us and our Clients".*

Opposing views still consider that D&B is risky and litigious. It will not lead to continuous work. Lack of trust is a fact.

Sub-Category Five, Quality and Innovation. (This category received critical comments).

Although the majority of the responses agreed that D&B delivers quality products, forty percent (40%) of the respondents stated that D&B option should be limited to factories and non-essential projects where creativity in design is not a major concern. To them, D&B means unnecessary repetition of work, and having a building where all elements have to fit the structural concept irrespective of appropriateness of use. Two managers said:

> *"Under D&B option, time takes priority at the expense of aesthetics and cost. The trade-off between time, cost, and quality is predetermined construction time becomes more important than innovative design and fitness for purpose. Many design mistakes are never corrected on time and clients have to live with them forever".*

Sub-Category Six, D&B Leads to an Effectiveness and Cooperative Team Environment.

The majority of the sample's participants supported this approach. To them, D&B option does create a participative work environment. Team members are capable of resolving their problems concurrently. They perform quality review checks "on-board" with each other. As the project proceeds, progress is noticed and measured. Opposing view consider that D&B can not be lead by contractors. Only novated client consultant can make D&B succeed. When something go wrong with D&B the client has no one to blame to rectify the mistakes.

Sub-Category Seven, D&B Option is Essential for Certain Rushed and Complex Projects.

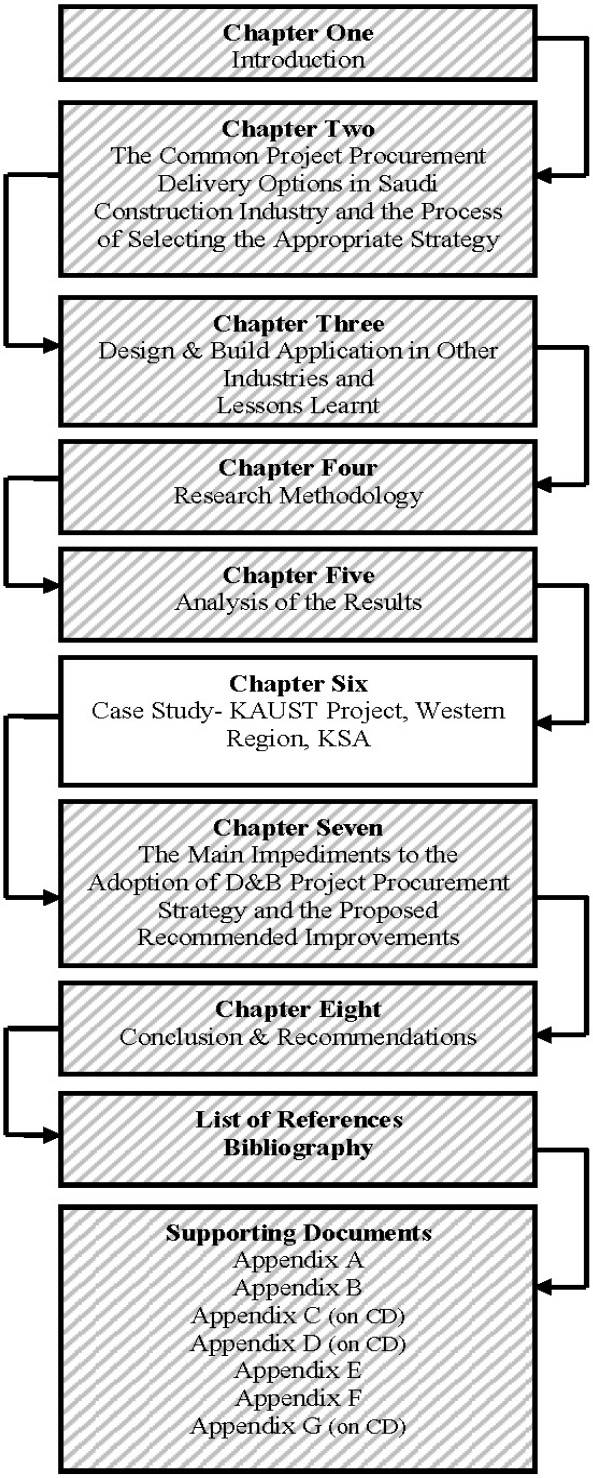
The respondents answered that D&B can be the answer for troubled projects, remote and complicated projects, and projects requiring high participation of the client and contractor. They agreed that D&B is ideal for such projects but it should not be the norm. Opposing views believe that D.B.B is also ideal for complex and rushed project if planned well from the outset.

Sub-Category Eight, D&B Approach Can Validate the Business Case and Feasibility of Critical Projects,

The answers to this last sub-category included the areas of cost, time, and choice of the optimum project delivery selection and the financing of projects. The answers were in agreement that the selection of D&B project delivery option can influence the performance of the project. Early completion of projects may mean earlier income and revenues. D&B firms are asked to provide decennial insurance coverage and this can present some challenges to many D&B firms.

The next chapter presents the case study selected for this research. The King Abdullah University of Science and Technology, KSA (KAUST).

Chapter VI
Case Study- KAUST Project, Western Region, KSA



6.0 Case Study: The King Abdullah University of Science and Technology (KAUST) in Western Region of Kingdom of Saudi Arabia

6.1 Introduction

The following case study for a university campus is selected and presented because of its relevancy to this study. Its scale, complexity, and international quality standard required and achieved are directly applicable. This project started in June 2007 following a Design and Build (D&B) procurement path, and was completed in (September, 2009). It illustrates the practical application of D&B strategy in the current Saudi construction industry. **Appendix (F)** pictorially shows the development of the construction activities from the undeveloped site in June 2007 to the completion of the university campus in July 2009.

The chapter presents a brief description of the project, its main components, and the approach taken by the client to plan, award and deliver this project along the D&B basis. It also presents the selected sample size for conducting the direct interviews with key participants who worked on this project. These participants represented The Saudi Arabian Oil Company (SAUDI ARAMCO), the consultant and the contractor. The responses and outcome of the interviews are presented followed by an analysis of the identified criteria for success, problem areas and lessons learnt. The project commenced on time, was completed slightly behind schedule and met the quality level stipulated by the client. However, the project was over budget. The structure and order of the relevant data and how the information is used relative to this chapter is detailed in **Figure 6.1.** The supporting documents are presented in separate appendices. The information presented herein is collected from the following sources:

1. Direct interviews with senior members of the client's team who managed the entire process from initiation to handing over.
2. Direct interviews with members of the consulting team.
3. Direct interviews with the contractor's site engineers/architects.
4. Direct interviews with the contractor's senior management key personnel representing the engineering, estimation, planning, procurement, and construction departments in Riyadh, Jeddah and Paris.
5. Regular site visits by the author to site from commencement of construction to project completion and handing over.

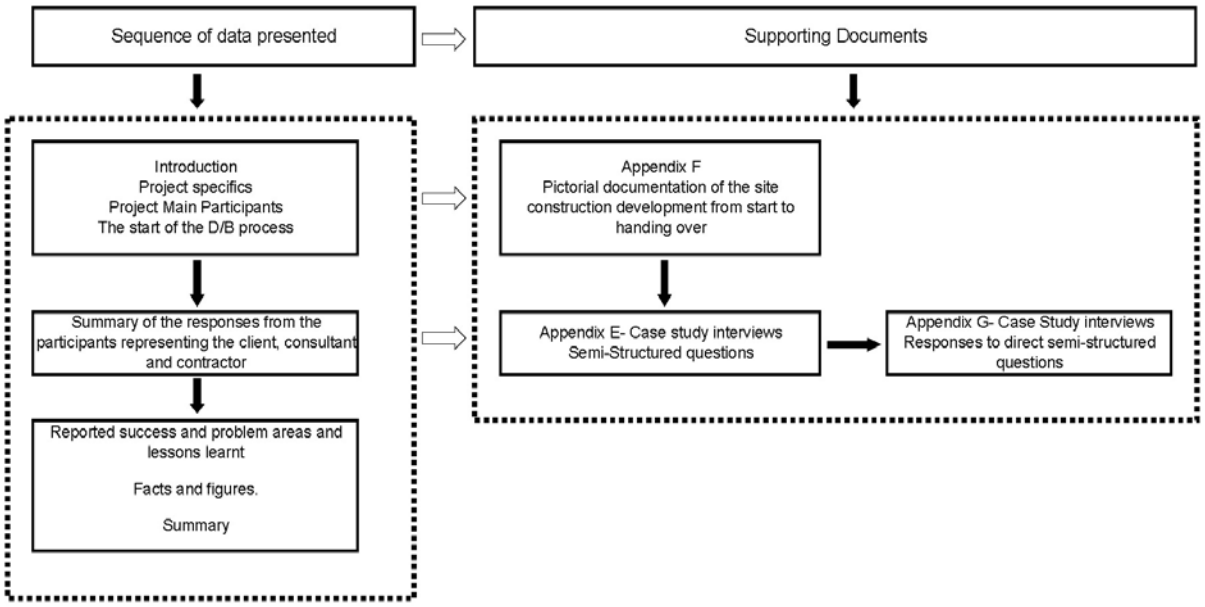


Figure 6.1. The Body of the Chapter and the Sources of Supporting Appendices.

6.2 Project Specifics

King Abdullah University of Science and Technology (KAUST) is envisioned to be a world class centre for inquiry and discovery, incorporating high level research and academic centers with an unparalleled campus community. It is conceived to be a place that fosters and promotes world class science. One of the keys to this ambitious endeavour is excellent facilities. State-of-the-art laboratories, equipped with the latest technology, are a fundamental element to the university's success in today's competitive research arena. The master plan addresses the realization of both the vision and mission of the University in physical form.

The project is located about 80 km North of Jeddah near the fishing village of Thuwal along the Red Sea coast. The university campus is organized on a site of 60 hectares that is delineated by a highway in a horseshoe form. At the heart of the university campus are the academic and administrative campus buildings with an approximate built-up area of about 495,000m². The University occupies 12km square of land area and 12km square of water area. Phase one of the development utilizes eight (8) kilometer square of the land area and the development of the entire coastal line. The project was originally anticipated to span fifty four (54) months with the construction starting in June, 2007. However, by end of 2006 the client asked for the project to be completed within twenty six (26) months from the issue of tender documents.

Vision: The University shall be one of the most attractive and outstanding scientific centers in the world that excel in creativity, innovation, and scientific research in specific strategic fields to support development and the national economy.

Mission: Conduct scientific research that will lead to discoveries and inventions and sponsor creative and talented Saudi and other students to support the development and the national economy in a special environment that provides higher education programs in strategic fields.

6.3 Detailed Project Description

The project comprises the following main components as detailed in **Figure 6.2** of the master plan.

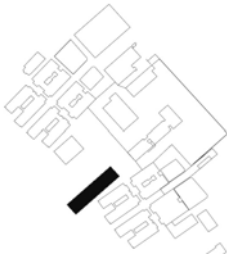
1. Academic and Administrative Campus.
2. The Residential Campus (two neighbourhoods)
3. The City Centre (commercial, entertainment and social activities)
4. The Central Plant and Support Facilities (two plants)
5. The Coastal/Marine development.

6.3.1 Academic Buildings:

The Academic and Administrative Campus was awarded on the Design and Build Cost Plus Fee Contract basis following the approval of the master plan design in March 2007. The remaining components of the master plan were awarded to local consultants following the traditional procurement path.

Applied Mathematics Buildings (8)

This building will house a majority of the functions for the fourth Research Institute of KAUST. The Applied Mathematics & Computational Science building will be more multipurpose than the other Research Laboratory Buildings and will house the Scientific Computing Centre. The gross floor area is: 25,000 m2



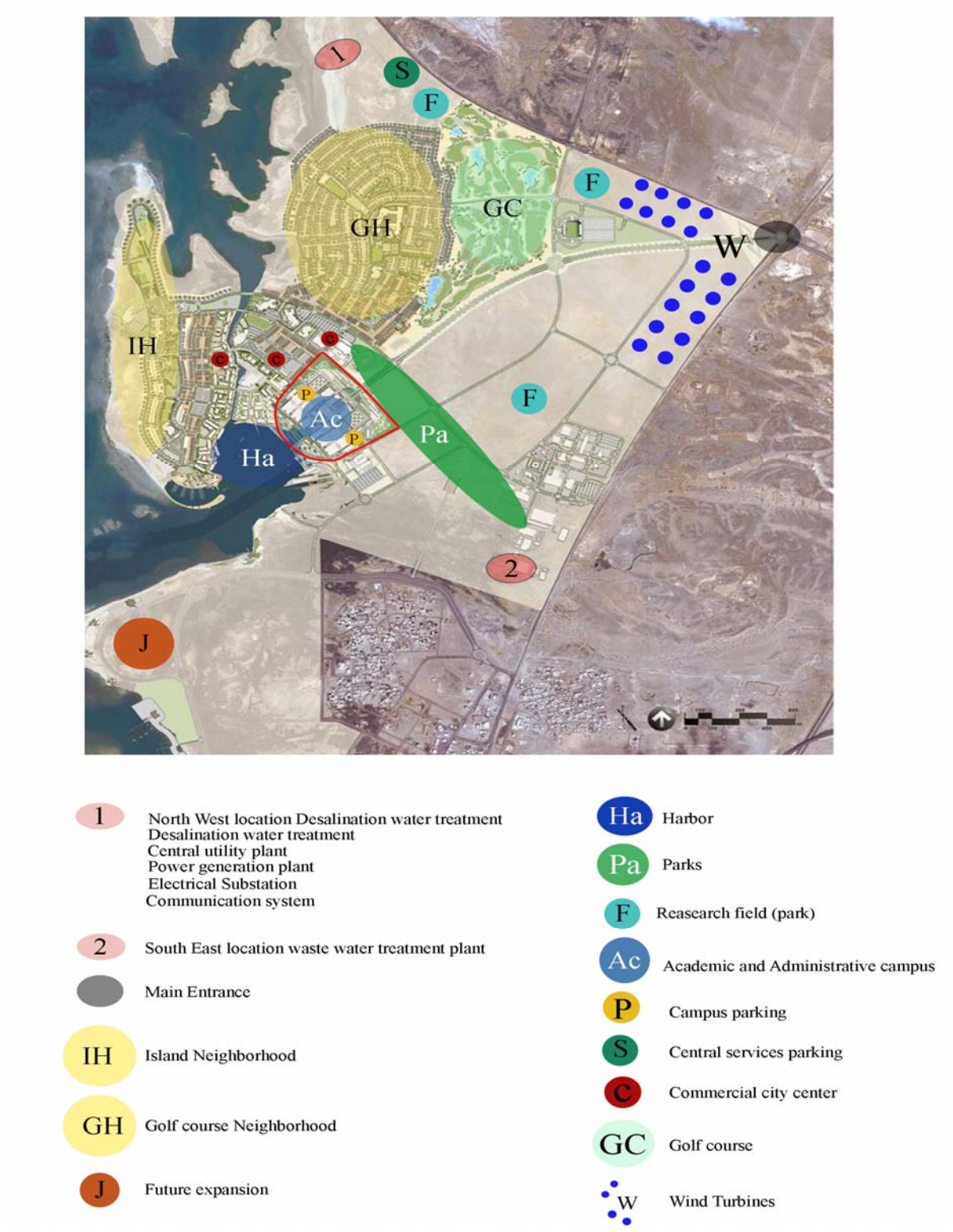


Figure 6.2. The KAUST Project Master Plan

Source: HOK, USA (with Permission)

The scope and limits of the Academic and Administrative Campus which is the scope of this case study is illustrated in **Figure 6.3.**

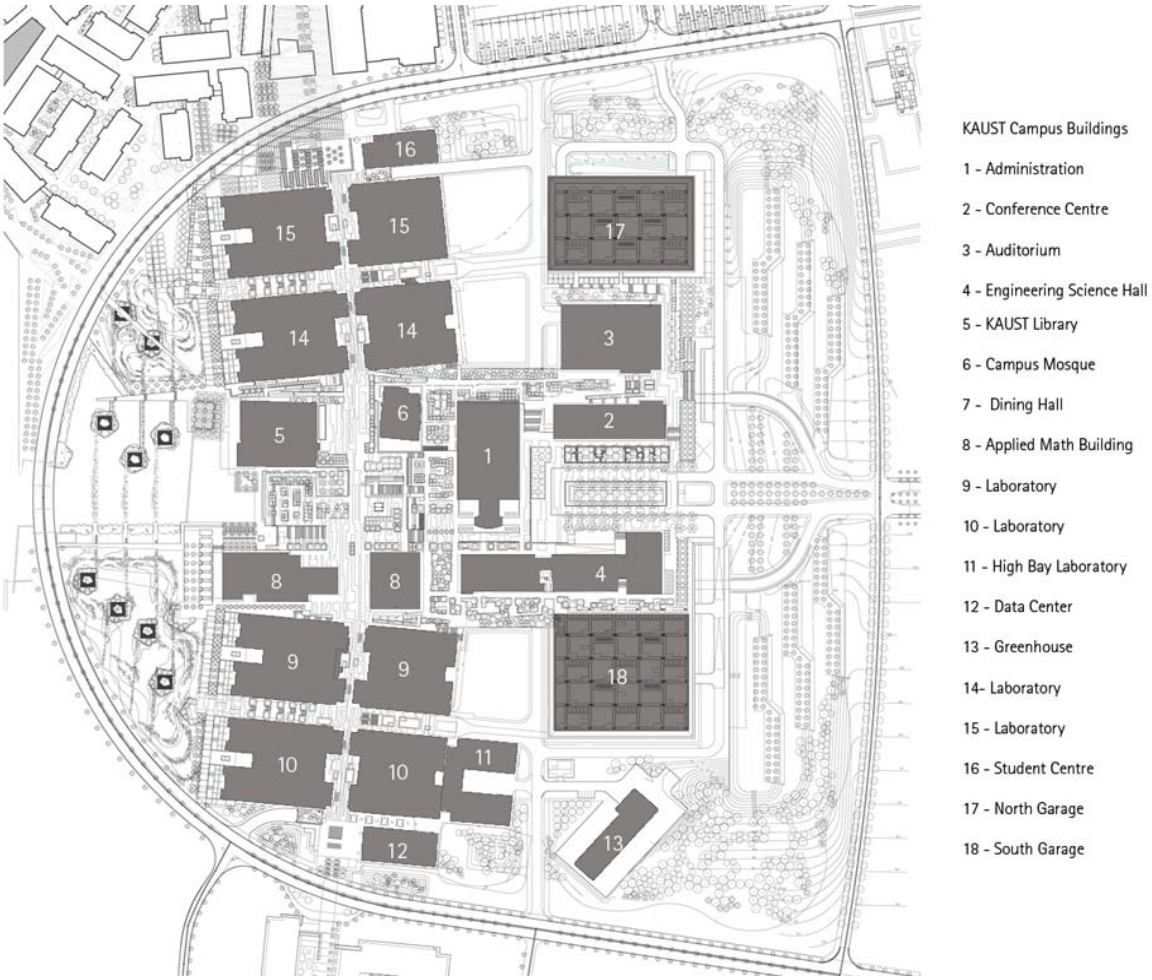
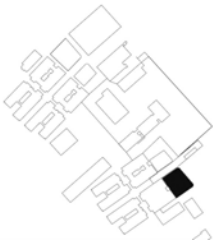


Figure 6.3. The limits of the Academic and Administrative Campus.
Source: HOK, USA (with Permission)

Research Laboratory Buildings (9,10, 14 & 15)

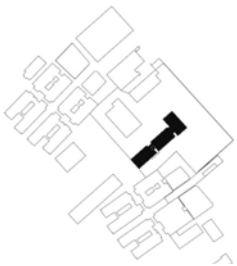
These buildings will house three of the Research Institutes and their related Research Centres. No building is dedicated to a single Institute, but instead, the Research Institutes will be organized to promote collaboration and interaction between researchers of all disciplines. The Research Laboratory Buildings will offer scientists state-of-the-art facilities and an exceptional work environment. The gross floor area of these four buildings is about 200,000 m2



South High Bay Lab 2 (11)

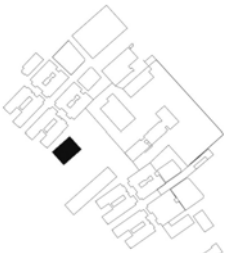
The south high bay lab 2 is an extension of the research lab 2, where the scientists could find more laboratory spaces and offices. The gross floor area is: 3,847 m2

Engineering and Science Building (4)



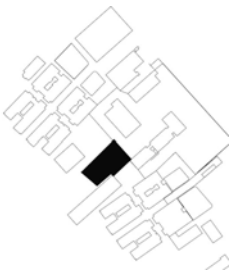
The Engineering and Science Building (ESB) will house classrooms to fulfill the coursework requirements of the Master of Engineering degree and the Master of Science and Engineering degree and the offices of the Dean of Science and the Dean of Engineering. In addition, the ESB provides space for the teaching faculty, meeting rooms and their related administrative offices. The ESB will also house the associated instructional / teaching labs along with the horizontal programs and their administrative space. The gross floor area of is: 22,500 m2

6.3.2 Administrative Buildings:



Campus Library (5)

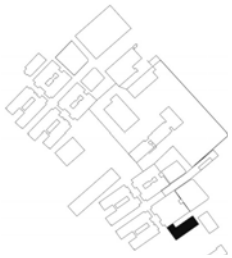
The Campus Library is the gateway to research information and ideas, both real and virtual. The library will support a living/learning work environment. The gross floor area is: 13,665 m2



The Commons (13)

The Commons includes the Dining Hall for faculty, staff and students and administration of the university and a small Exercise Room. The Exercise Room is a small exercise facility, including cardio and weight machines, located near the academic buildings. The gross floor area is: 9,000 m2

Business Data Centre (12)

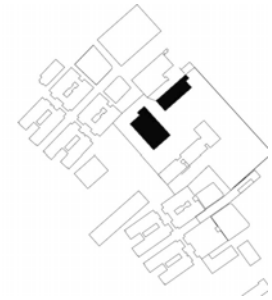


The Business Data Center (BDC) is the primary administrative computing facility at KAUST. It provides a secure, dedicated facility for the installation, operation, and administration of data processing equipment and services for University operations.

The gross floor area is: 7,500 m2

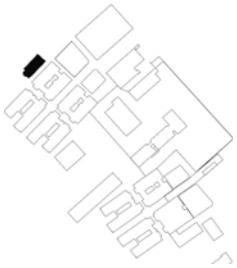
Administration, Conference Centre and Support Services Building (1, & 3)

The Administration building will house the university's administrative staff while the Conference Center is the public and visitor interface to the KAUST campus. It will be the primary location for public performances, visiting lecturers, and tourists. The Conference Center includes an Auditorium and Multi-Purpose Rooms as well as, a Museum and Media Center. The combined gross floor area of these buildings is: 36,974 m2.



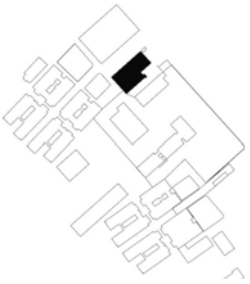
University Centre (16)

This Centre will be a bridge between the university campus and the community. It will have a storefront style access to the public and will house the bookstore, fellowship hall, and clubrooms, lounge/game rooms, a café, as well as, the offices for Residential & Retail Services and Faculty and Student Affairs. The gross floor area is: 7,400 m2



Auditorium (3)

The Auditorium is for large gatherings and may accommodate lectures as well as live performances. The auditorium is planned for 1,000 seats. The gross floor area of this building is: 9,500 m2



Parking Garage (17 &18)

This is two-storey concrete frame building with a capacity for 3000 cars for employees and visitors. The gross floor area of this building is: 93,000 m2.

The built up areas of the Academic and Administrative campus is shown in **Table 6.1.**

6.4 Project Main Participants

6.4.1 The Client

The intention of the government of Saudi Arabia, the client, was to build a world class, postgraduate research institute that will foster innovation in the fields of science

Table 6.1. Total Built- Up Areas of the Academic and Administrative Campus.

Description	Building #	Gross internal Floor Area m2
UN 1450-Campus library	5	13,665
UN1500- the Commons	13	7,489
UN1550-Applied Mathematics	8	30,806
UN 2200 – Business Data Centre	12	7,517
UN 2300 – South Research Laboratory 2	9	52,726
UN 2400- South Research Laboratory 1	10	52,726
UN 2450- Mosque	6	2,041
UN 2500- Administrative Building	1	36,974
UN 2550- Support Services	17	2,610
UN 2600- North Research Laboratory 2	14	52,726
UN 2700- North Research Laboratory 1	15	52,726
UN2800- university Centre	16	7,405
UN 3200 – Green house	6	1,543
UN3300 – South High Bay Laboratory 2	11	3,847
UN 3450 – Engineering &Science Building	4	22,518
UN 3500 – Garage (South)	21	112,481
UN3525 – Garage (North)	21	18,530
UN 3550 Conference Building	19	Included in UN 2500
UN 3555 – Auditorium	3	16,733
Total Build Up areas		**495,063**

and technology and to serve the growing needs of continued developments in the Kingdom of Saudi Arabia. The need for this academic project was declared in early 2006. The challenge was to build and handover the project by end of July 2009. Due to the complexity of the project, the client (Ministry of Education) commissioned SAUDI ARAMCO as the program manager to project manage the planning, design, procurement, construction and hand over of the project. SAUDI ARAMCO is known for its technical and managerial resources and ability to manage industrial and complex projects of different sizes, ranging in cost to Multi-Billion Saudi Riyals (SR).

6.4.2 The Consultant

The principal consultant selected for the project was HOK- USA. SAUDI ARAMCO selected this international design firm because HOK is a well known international consulting firm that has a track record for successfully designing and managing similar projects internationally and domestically. They had experience in the region, including the design of King Saud University in Riyadh, Kingdom of Saudi Arabia, in the late 1970's. HOK also appointed over 60 specialist consultants for specific areas including, Health and Safety, Signage, Laboratory specialists, Audio Visual, Security, Lighting etc…. All these specialists were managed by the principal consultant.

6.4.3 The Contract

The contract between the client and the contractor is titled "Design and Build, Cost Plus FEE Contract". The contract was signed with limited design information, performance specifications and limited schedule of rates, and a fixed completion date. The client adopted a D&B procurement The contract stipulated the following terms:

- The D&B contracting firm will be responsible to develop the preliminary design information issued by the nominated consultant (HOK) and provide construction documentation and shop drawings for the project. The consultant shall provide design packages developed to the preliminary design level and others were to the design development stage. The D&B contracting firm is responsible to coordinate all design activities, provide the required engineering and design support to enable the construction of the project.
- The contract offered the contractor a FEE for risk and performance and profit expressed in a percentage (%). The FEE was structured such that the percentage

(%) decreases as the overall project value of the works increases. In addition, the contract allowed for the following variations:

- Materials and equipment directly supplied by the client will be managed and handled by the main contractor for an agreed fee percentage (%) for management, installation, overhead and profit.
- The contract offers the contractor a fixed fee percentage (%) for managing the procurement of the client supplied work packages which will be available at various times during the construction stage.

The contract stipulated that, once the design for the various work packages is ready for tendering, the main contractor would manage these work packages and issue them for tendering in close coordination with the client's site team. Each work package is considered a contract by itself and includes the items listed below:

- Estimated budget (based on the project budget).
- Time schedule (based on the project milestones and completion dates).
- Detailed scope description for Work Unit Rate Item (WURI).
- Supervisory Personnel requirements.
- Identified Subcontractors/Suppliers.
- Consultants as required.

The rates and cost of the external works, foundations, and structural frame were agreed at tendering stage. Construction work was planned to commence on site on this basis. All unit rates (material, personnel, equipment) identified and agreed upon were invoiced monthly on completion. New items resulting from the developed design would be quantified and measured by the main D&B contractor. A new rate would be applied based on either market rates or a mutually agreed rate with the SAUDI ARAMCO's cost consultant. Other major packages such as the lifts, curtain wall, and cladding would be issued to a selected list of acceptable tenderers and subcontractors or suppliers for bidding.

The contract stated that returned bids would be opened in the presence of SAUDI ARAMCO. The sub contractor with the best offer would be awarded the contract. Once a package is awarded, SAUDI ARAMCO would issue a WORK AUTHORIZATION RELEASE (WAR) to the contractor acknowledging the new contract scope and sum. No additional time would be negotiated since the end date was fixed at the tender stage. The contract clauses requested that the D&B contractor evaluates and submits a cost estimate

and budget forecast. This is to occur throughout the evolution of the design with an accuracy level equivalent to +/-10% at 30%, at 60% and 90% design completion.

With the full brief defined, the procurement process started as planned along the D&B path. **Table 6.2** presents the main milestone dates planned for the project.

6.4.4 Tendering and Contract Award

The consultant presented the approved concept master plan by early March 2007. SAUDI ARAMCO advised that it was their intention to commence construction at the earliest possible time. The consultant was requested to provide proposals for the construction procurement procedures based on a fast track, D&B approach. In mid March 2007, SAUDI ARAMCO invited three main local contractors namely, (SOL, SBG, CCC) to tender on D&B basis, for the Academic and Administrative Campus. The consultant issued the master plan of the Academic and Administrative Campus with preliminary design documents, reports, and schedule of rates comprising technical and financial commercial information as follows:

6.4.4.1 Technical Part.

1. Master plan of the entire campus.
2. Master plan of the Academic and Administrative Campus.
3. Technical reports.
4. Site survey drawings.
5. Completion milestone dates (refer to table 6.2).
6. Preliminary specifications for concrete and earthworks.
7. Contract conditions.

6.4.4.2 Pricing documents (without quantities BOQ)

8. Schedule of Work Unit Rates. (mainly for structural items, few finishing items, electrical/mechanical items and external works). WUR
9. Schedule of Time Unit Rates (Equipment) TURE.
10. Schedule of Time Unit Rates. (Personnel) TURP.

Bids were returned on 12 May 2007 in two parts including a commercial proposal and a technical proposal. SAUDI ARAMCO evaluated the technical proposal first and the commercial terms of the technically qualified bids were opened and evaluated later.

Table 6.2. Key Milestone Dates for the Project.

No.	Milestone Title	Date
1	Establish the need for the project	15 April 2006
2	Site selection	20 May 2006
3	Commission the consultant	16 June 2006
4	Develop the main scope of the project in general terms	22 Sept 2006
5	Prepare the space program & major components of the university campus, residential & support facilities.	20 Dec 2006
6	Issue conceptual master plan to three contracting firms with preliminary tendering & contractual documents	26 March 2007
7	Issue developed master plan for pricing purposes	25 April 2007
8	Bids submitted to SAUDI ARAMCO (commercial proposal & technical proposal)	12 May 2007
9	Construction D&B contract award.	12 June 2007
10	Kick-off meeting at HOK's offices a) agree split and scope of work and contractual arrangements b) agree on the contractual work authorization release (WAR) c) mobilization plan, personnel, equipment d) subcontractors, material, procurement, workforce	14 June 2007
11	Agree division of procurement path as follows: a) Academic & administration campus on D&B basis b) All other facilities on the traditional path	25 June 2007
12	Commence site mobilization, site surveys & soil investigation	16 June 2007
13	Issue first earth work (rough grading) package	09 July 2007
14	Target complete mobilization	13 July 2007
15	Issue foundation design packages for all buildings first followed by all structural works.	04 Aug 2007 till 5 June 2008
16	Issue MEP design packages	13 Sept 2007 till 7 April 2008
17	Issue facades design packages	22 Dec 2007
18	Issue internal finishes design packages	15 May 2008 till 10 Dec 2008
19	Issue Fit-out design packages	15 April 2008 till 31 Aug 2008
20	Issue complete internal MEP design packages	10 Oct 2008 till 10 Jan 2009
21	Issue landscape and external design works	22 Nov 2008 till 10 Feb 2009
22	Complete commissioning for beneficial occupancy	30 June 2009
23	Project completion and demobilization	31 Aug. 2009

6.4.5 The Contractor(s)

Following direct negotiations between SAUDI ARAMCO and the contracting firm, (SOL) on 12 June 2007, SAUDI ARAMCO awarded SOL contracting firm the Academic and Administrative Campus on D&B basis. The project master plan was split into five main components**.** Due to the complexity of the Academic and Administrative Campus, the client decided to procure this Campus, solely using a D&B option. The remaining

master plan components were procured using the traditional path through local design firms.

6.5 The Start of the Design -Build Process Following the Contract Award

Immediately after contract award, the client called for a kick –off meeting at the consultant's offices in the USA. Key points discussed during this meeting were:

1. Contract management.
2. Definition of the scope of work (Work Packages).
3. Project schedule.
4. Design responsibilities.
5. The concept of WORK AUTHORIZATION RELEASE (**WAR**)
6. Mobilization of staff, technical team, estimating teams, equipment.
7. Mobilization of the subcontractors.
8. Interface with other contractors.
9. Phasing of design packages, procurement and construction
10. Commissioning, Handing over and Demobilization.

Splitting the main D&B contract into two parts was a major decision considered at the team kick- off meeting. This was required due to the complexity of the project and the need for SAUDI ARAMCO's team to be located close to the design team. Therefore, the Academic and Administrative Campus contract was split into two parts as follows:

1. In Kingdom Contract **(IK)** Contract with the contractor for work inside the Kingdom of Saudi Arabia
2. Out of Kingdom Contract **(OOK)** Contract with the contractor for work outside the Kingdom of Saudi Arabia.

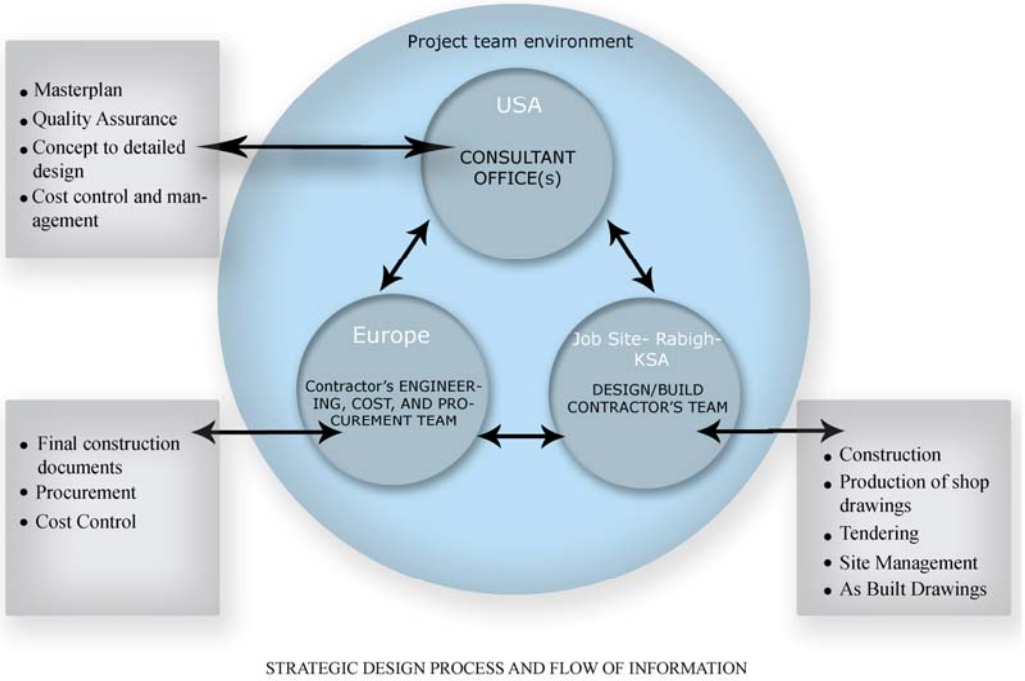
The design contract remained with HOK. However, the D&B contractor's duty is to work with the consultant and assist in developing the design to construction documentation, addressing issues of constructability. To achieve this objective, the presence of the contractor at the offices of the consultant was essential. This task was assigned to the contractor's office in Europe (OOK). The organization chart and responsibilities of each party to the contract are illustrated in **Figures 6.4** and **6.5** respectively. This decision was deemed necessary to facilitate communication, and management of the project, and movement of personnel between the various work locations namely:

1. HOK's offices in the USA,

2. The contractor's engineering offices in France (Oger International)
3. The contractor's design, procurement, and construction head offices in Riyadh and Jeddah, Saudi Arabia (IK).

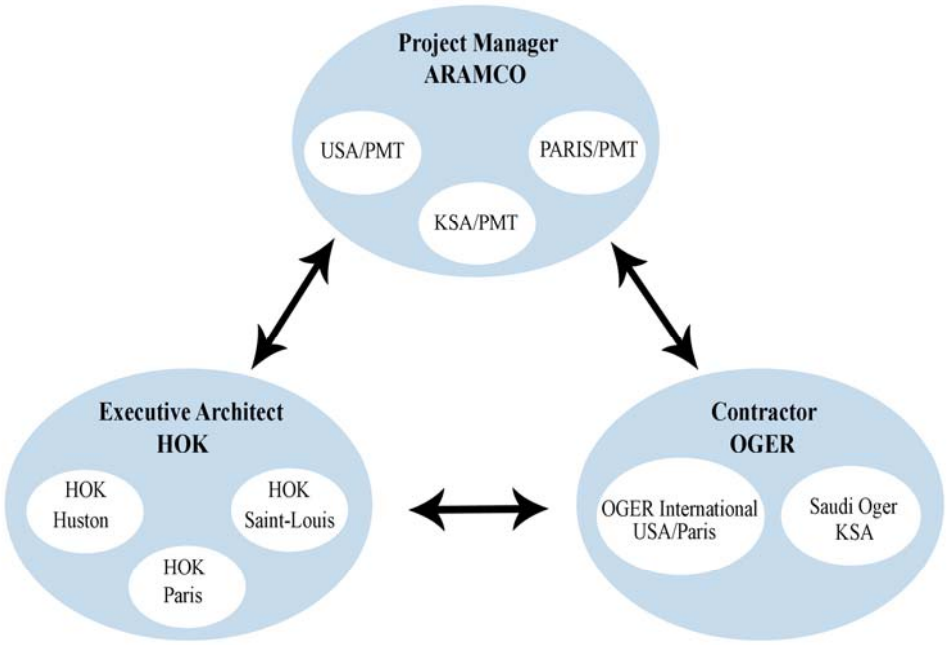
The details of the responsibilities for (OOK and IK) are explained in **Tables 6.3** and **6.4** respectively. Another outcome of the kick-off meeting was the agreement to have biweekly workshops. These team workshops aimed at defining the best way to overlap design and construction activities, resolve design, procurement and construction issues and find the optimum cost levels. During the early workshops the joint team defined 14 design and construction packages**.** This was based on the analysis of the requirements for the optimum sequence of design time, tendering/evaluation and construction periods.
The identified work packages are as follows:

PK1 Excavation, rough Grading and Site Fencing and soil improvement
PK2 Bore holes stone columns.
PK3 Underground Foundation including ground floor slab (All Buildings).
PK4 All structural works above ground. (All remaining construction work).
PK5 All external structural works.
PK6 All Long lead Mechanical and electrical (Lifts, AHU, HVAC controls, Substations, Panel Boards, Atrium Glass roof, Terracotta tiles, etc…).
PK7 All internal Mechanical works (Chilled water pipes, controls, Pumps etc…).
PK8 All internal Electrical works. (Cables, cable trays, Panel boards, etc...)
PK9 Laboratory Hoods and Exhaust Ducts.
PK10 Building Enclosure (Curtain wall and Terracotta tiles, Roof Panels).
PK11 Internal Finishes (Tiles, Partitions, Metal works, Ceilings, Paint, Signage).
PK12 All landscape works and external works.
PK13 Furnishing, Fitting and equipment (with ten sub packages).
PK14 Exterior Improvements, waterways and Marine construction.



STRATEGIC DESIGN PROCESS AND FLOW OF INFORMATION

The presence of the client, consultant, and contractor at the three project bases. (USA, Europe, KSA)



* PMT: Project Management team

* KSA: Kingdom of Saudi Arabia

Figure 6.4. The Presence of Each Party to the Contract at the Three Main Locations and their Role.

Source: HOK, USA (with Permission)

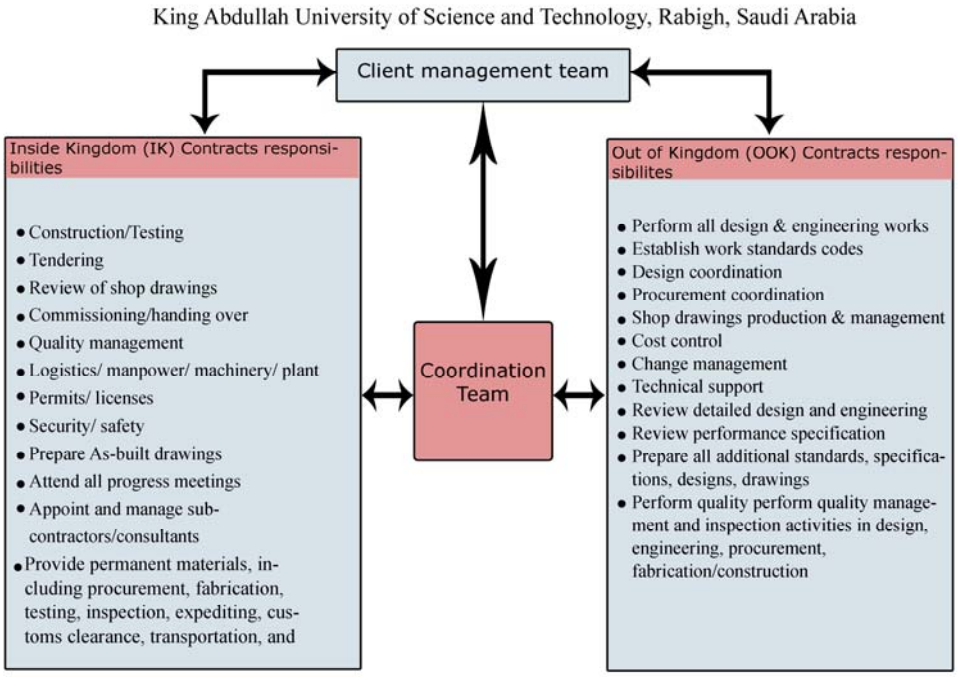


Figure 6.5. Contractual Responsibilities and Duties for IK and OOK Contracts

Table 6.3. Contractual Responsibilities under the Inside Kingdom (IK) Contract

1	Assist as necessary in the Affiliated Contractor's review of the drawings, specifications and standards to ensure full compliance with specification and standards referenced in this contract.
2	Construct and conduct final testing, inspection and checkout of the facilities.
3	Provide Contractor-Supplied permanent materials and spare parts for the facilities, including but not limited to, procurement, fabrication, inspection, expediting, customs clearance and transportation.
4	Perform quality management and inspection activities in procurement, fabrication/construction, testing and pre-commissioning.
5	Provide support facilities, machinery, construction plant and equipment required to perform the WORK (Contractor's Equipment).
6	Provide all the labor and supervision required to perform the Work (Contractor's Personnel).
7	Obtain all permits, licenses and other governmental authorizations, which are necessary for the performance of the Work except for those, which must be obtained in Saudi ARAMCO'S name.
8	Provide proper security at the Work Site and at contractor's materials yard acceptable to Saudi ARAMCO.
9	Provide As-Built drawings and project record books, all in English, to facilitate operation and maintenance of the facilities. Provide commissioning and start-up assistance.
10	Provide and maintain through project completion the engineering, procurement and construction support required for the resolution of engineering, procurement, installation, construction and commissioning.
11	Participate in regular work progress meetings to be scheduled by the company representative.
12	Appoint one or more contractor representatives for the duration of the Work. At least one qualified and experienced representative shall be present at the principal location where the work is being performed.
13	Perform all other obligations, work and services and furnish all other things which are required by the terms of this contract or which can reasonably be inferred from the terms of this contract as being necessary for the successful and timely completion of the Work.

Source: SOL (with Permission)

Table 6.4. Contractual Responsibilities under Out Of Kingdom (OOK) Contract

1	Perform detailed design, shop drawings and engineering for the facilities in accordance with the drawings, specifications and standards described so that the facilities can be constructed, operated and maintained in accordance with Facilities Performance Specifications.
2	Prepare all additional standards, specifications, designs, shop drawings and other documents required for the design, procurement of materials for, and construction of the facilities.
3	Perform quality management and inspection activities in design, engineering, procurement, fabrication/construction, testing, pre commissioning, and commissioning.
4	Assist in procuring the support facilities, machinery and equipment required to perform the Work (Contractor's Equipment).
5	Assist in obtaining all permits, licenses and other governmental authorizations, which are necessary for the performance of the Work.
6	Provide technical review team and cost consultants to work with the design consultant in USA and at the project site.
7	Appoint a full team multi-disciplinary to be located at the consultant's offices in USA to review design drawings and perform quality check.
8	Provide facilities for a Company Project Management Team to be located at the principal location(s) of the work. Contractor shall provide complete clerical and secretarial staff assistance, as well as, such additional incidental support as may be reasonable and appropriate, as requested by SAUDI ARAMCO.
9	Participate in regular work progress meetings scheduled by the consultant and/or SAUDI ARAMCO representatives.
10	Monitor and manage the process of the LEED certification and relevant implementation on site.
11	Manage the process of variation orders, claims and their resolutions.
12	Provide the facilities and participate in all discussions and design workshops with the specialist consultants.
13	Review and approve all As-Built drawings and documentations and procedures for handing over and project close out.

Source: SOL (with Permission)

6.6 Summary of the Responses from the Participants Representing the Client, Consultant and the Contractor.

This section summarises the results of the data received from the direct interviews with the sample. The author conducted direct interviews with representatives from ARAMCO, the consultant and the contractor representing architectural, engineering, cost consultants, and project managers. These participants were directly involved in the project. The respondents were asked to express their views and provide answers regarding several key issues as detailed in **Appendix (E).** The questionnaire is composed into three parts. The first part is addressed to the client representatives, the second is addressed to the consultant representatives, and the third is to the contractors'. The questions cover the following subject areas which are directly related to the research questions:

1. What is their knowledge with D&B project procurement options?
2. Did this D&B project meet the established time, cost and quality targets?
3. Did they use a project procurement selection system for this project?

4. Did they use a prequalification process to select and award D&B projects?
5. Who prepares the RFP scope of work and the contractual arrangements?
6. Did they encounter problems or delays to obtain the building and construction permit approvals?
7. The performance of the client, consultant and contractor throughout the delivery process.
8. How would they describe the performance of the suppliers, manufacturers and sub-contractors during the PLC?
9. What do they consider as the main factors for the success of the project and the major problems they encountered?
10. What do they consider as the impediments to the adoption of D&B option?

A total of Sixteen (16) direct interviews were conducted with key persons responsible for the delivery of this project. Details of the participants are presented in **table 6.5**. The interviews started in late 2008 and were completed by December 2009. Two interviews with project managers from ARAMCO were completed in April 2010, in the UK. For reasons of confidentiality, the names of the participants and persons interviewed will not be disclosed. The author received permission to present this case study from ARAMCO, the consultant and the contractor.

Table 6.5. Case Study Sample Size and Distribution of the Participants.

#	Size and mix of the sample participating in the case study interviews	Responses out of (16)	%
1	Participants from the Client	4	25
2	Participants form the prime Consulting office	5	31
3	Participants from the Contractor on site and at head office.	7	43
	Total	16	100

The author attempted to obtain permission from the client to discuss financial details. However, since some information was too sensitive, it was not possible. All answers from the client, consultant and contractor representatives were grouped into three distinct sections representing these main parties as documented in **Appendix (G).** Before commencing the analysis the answers were first edited, classified, and then analyzed. The frequencies of the responses that associated with each category of questions were

statistically calculated, computed and distributed according to the relevant category supported with percentages of the responses. Following that comments on these findings are provided.

6.6.1 Responses Received from the Client Participants.

Arranging interviews and meetings with the client's representative was difficult. The senior management team was always busy. Although the author's firm is the D&B firm building this project and direct contact with the client and consultant was not an issue, only four direct interviews were possible with the client's technical site management team. Two interviews were with two site engineers, one with the quantity surveyor and one with one of the project managers. Letters asking for the interviews and the reasons for them were sent to the head of projects at ARAMCO site offices in July 2008.

Q. 1	**Knowledge and experience with D&B project delivery option.**	**Responses out of (4)**	**%**
	Aware	3	75
	Not Aware	0	0
	Vaguely Aware	1	25
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Responses out of (4)**	**%**
	Aware	4	100
	Not Aware	0	0
	Vaguely Aware	0	0
Q. 3	**Did this D&B project achieve the contract budget targets?**	**Responses out of (3)**	**%**
	Yes	0	0
	No	3	75
	Not sure	1	25
Q. 4	**Did this D&B project achieve the contract schedule?**	**Responses out of (4)**	**%**
	Yes	3	75
	No	1	25
	Not sure	0	0
Q. 5	**Did this D&B project achieve the stipulated quality standards?**	**Responses out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not sure	1	25
Q. 6	**Did you use an industry standard project procurement selection system or model to choose the optimum project delivery system for your projects?**	**Responses out of (4)**	**%**
	Yes	2	50
	No	1	25
	Not sure	1	25

Q. 7	**Why did you choose the D&B project delivery option for this project?**	**Responses out of (4)**	**%**
	Speed	(3)	(75)
	Lower cost	0	0
	Certainty of price	0	0
	Better quality	((1))	(25)
	Due to government contractual laws	0	0
	Better risk management	(1)	(25)
	Familiarity with this option	0	0
	Certainty of delivery	(1) ((1))	(50)
Q.8	**Did you use a standard D&B form of contract to procure this D&B project or did you develop a bespoke form of contract?**	**Responses out of (4)**	**%**
	Used a standard contract form	2	50
	Developed a bespoke contract form	1	25
	Not sure	1	25
Q. 9	**Who prepared the scope of work for this D&B project?**	**Responses out of (4)**	**%**
	Prepared in- house.	3	75
	Out- sourced to an independent entity	0	0
	Combined effort between in-house and independent entity.	1	25
Q. 10	**What process did you follow to select the D&B entity for this D&B project?**	**Responses out of (4)**	**%**
	Two-stage prequalification selection process.	4	100
	Lowest offer is awarded the project.	0	0
	Select D&B firm based on track record.	0	0
Q. 11	**At what stage of the project life cycle did you invite the D&B firms to bid for this D&B project?**	**Responses out of (4)**	%
	Following the preparation of the RFP document	0	0
	Following the preparation of the Master plan document.	4	100
	Following the preparation of the architectural concept design stage	0	0
	Following the preparation of the architectural preliminary design stage	0	0
Q. 12	**Did you encounter problems or delays to obtain the planning and building permits approvals?**	**Responses out of (4)**	**%**
	Yes	0	0
	No	3	75
	Occasionally	1	25
Q. 13	**Were you satisfied with the end result of the project?**	**Responses out of (4)**	**%**
	Yes	3	75
	No	0	33
	Not sure	1	25
Q. 13	**Would you recommend the adoption of the D&B project delivery option for your future projects?**	**Responses out of (4)**	**%**
	Yes	3	75
	No	0	0
	In specific circumstances	1	25
Q. 14	**In your opinion, what were the criteria of success for this D&B project?**	**Responses out of (4)**	**%**
	Common knowledge and understanding with D&B project delivery option among the client, consultant and	4	100

	contractors organizations.		
	Availability of proper project brief from the outset.	2	50
	Proper planning of all critical milestones.	3	75
	Tendering process was very transparent and allowed construction to start with little design information.	4	100
	Our presence at the consultant and contractors' office to make on-board decisions.	4	100
	The selection of a capable consulting and contracting firm knowledgeable with D&B process.	3	75
	Problem solving and change orders committee was created which proved to be effective.	3	75
	Communication protocol of drawings and correspondences were well established.	3	75
	The detailed design was progressing with construction in mind.	3	75
	We devised systems for strict QA/QC procedure and early warning systems to measure cost and schedule overruns.	3	75
	Client, consultant and contractor were working as one team with one goal.	4	100
	Conflicts due to differences in rates, quantities changes in scope were resolved immediately.	3	75
	We secured phased permits approval from local authorities to allow phased delivery.	2	50
	We invited the contractor to attend the technical and procurement workshops to propose design and construction solutions.	2	50
	We handled the procurement of most of the expensive items.	2	50
	Tendering of critical items was handled openly with cost plus mark-up to the contractor.	2	50
	The focus was on getting the project built on time.	4	100
Q. 15	**In your opinion, what were the main problems encountered in this D&B project?**	**Responses out of (4)**	**%**
	Shortage of time to design and construct the project gave us little time to review design and tender packages.	4	100
	Lack of local experienced professionals with D&B project delivery option.	2	50
	Because of the Cost Plus contractual arrangements the final cost of the project exceeded the initial budget by over 35%.	4	100
	Construction started without proper engineering drawings. Foundation design was changed after site excavation.	3	75
	We were covering almost all risks in the design and method of construction.	3	75
	The local construction industry could not support the procurement of many construction materials and equipment components. The alternative was to specify products from abroad which was costly.	3	75
	At certain instances we were taken hostage by the contractor who controlled time, construction methods and procurement of material.	2	50
	We were constantly making trade-offs between cost, time and quality.	3	75

	Some decisions were made in a rush which proved to be wrong.	3	75
	The management of the project was too costly.	3	75
	The value of early possession of the project was costly.	4	100
	The commissioning and handing over procedures were rushed.	3	75

Comments:

The results did not come as a surprise to the investigations. The project achieved its quality and time schedule, but failed to meet the contract budget. The majorities of these respondents seventy five percent (75%) are aware of the D&B project delivery option and have used it on their projects. This client is aware of an industry project procurement system and which was confirmed by fifty percent (50%) of the respondents. Speed was the main reason for using D&B project delivery option for this university campus. In addition, this client used a two-stage, best practice evaluation process to select and award the contract. The award of the D&B contract was after the master plan is completed. The key success areas were related to:

- Client, consultant and contractor were working as one team with one goal.
- The awareness of the parties with the D&B contracting
- Tendering process was very transparent and allowed construction to start with little design information.
- The client was present at the consultant and contractors' office to make on-board decisions.
- The focus was on getting the project built on time.

The main problem areas were:

- Shortage of time to design and construct the project.
- Because of the Cost Plus contractual arrangements, the final cost of the project exceeded the initial budget by over thirty five percent (35%).
- We were covering almost all risks in the design and method of construction.
- The management of the project was too costly.
- The commissioning and handing over procedures were rushed.

6.6.2 Responses Received from the Consultant Participants.

Arranging interviews and meetings with the consultant was relatively easier. This was due to the close proximity of the consultant and the D&B contracting team. Five direct

interviews were conducted with the design team representing the design departments and site support team. Three direct interviews were made with the architectural planner and MEP senior engineers and two with the site engineers. Letters and emails were sent to the head office of the consultant in the USA asking for the interviews and stating the reasons for requesting them. Approval emails were received and interviews were arranged between March and December 2009 at the convenience of the participants.

Q. 1	**Knowledge and experience with D&B project delivery option.**	**Responses out of (5)**	**%**
	Aware	4	80
	Not Aware	0	0
	Vaguely Aware	1	20
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Responses out of (5)**	**%**
	Aware	4	80
	Not Aware	0	0
	Vaguely Aware	1	20
Q. 3	**Did this D&B project achieve the contract budget targets?**	**Responses out of (5)**	**%**
	Yes	2	40
	No	2	40
	Not sure	1	20
Q. 4	**Did this D&B project achieve the contract schedule?**	**Responses out of (5)**	**%**
	Yes	3	60
	No	1	20
	Not sure	1	20
Q. 5	**Did this D&B project achieve the stipulated quality standards?**	**Responses out of (5)**	**%**
	Yes	3	60
	No	1	20
	Not sure	1	20
Q. 6	**How was the performance of the client during this D&B project?**	**Responses out of (5)**	%
	Very good. Collaborative, proactive, making timely decisions, met contract payments.	4	80
	Fair. Showed adequate understanding of the scope Followed the contract requirements.	1	20
	Caused delays in responses. Introduced many changes and disruptions to the work.	0	0
Q. 7	**How was the performance of the contractor during this D&B project?**	**Responses out of (5)**	%
	Very good. Collaborative, proactive. Forward looking. Aware of the contractual challenges.	4	80
	Fair. Demonstrated a combination of good and poor performance.	1	20
	Not collaborative. Unprepared to deliver the project on time. Lacks sufficient experience and knowledge with D&B project deliver option.	0	0

Q. 8	**In your opinion, what were the critical successful targets achieved on schedule/cost/quality?**	**Responses out of (5)**	**%**
	The determination of the client to facilitate all matters related to preparing the master plan.	4	80
	The presence of the client at our offices while developing the scope of the project.	3	60
	Having a workable method for all key milestones for tendering, procurement and construction.	3	60
	The prequalification and tendering process was very transparent and allowed construction to start with little design information.	4	80
	The presence of the client and contractors at our offices to make on-board decisions and value engineering was key to the success.	4	80
	Packaging the design for tendering and construction helped in permitting an early start on site.	3	60
	The selection of a capable contracting firm knowledgeable with D&B process was vital.	4	80
	The work environment was collaborative and participative with risk sharing.	4	80
	Long lead items were identified from the outset and treated with extreme urgency.	3	60
	Communication protocol of drawings and correspondence was very effective.	3	60
	The detailed design was progressing with construction in mind. Common details and critical engineering and procurement issues were raised and resolved during the planned workshops.	3	60
	The client, consultant and contractor were working as one team with one goal.	4	80
	Conflicts and variation orders were resolved immediately.	3	60
	The contractor was part of the design team, proposed design and construction solutions to facilitate constructability.	3	60
	The use of BIM technology helped resolve many complex design issues.	3	60
Q. 9	**In your opinion, what were the major problems encountered in this D&B project which contributed to the delay or increased cost?**	**Responses out of (5)**	**%**
	Time pressure forced us to make some simpler designs for some areas. Some mistakes reached the site unnoticed.	4	80
	Lack of site information led to the redesign of the foundation package soon after the site excavation was completed. This resulted in additional costs to the client.	3	60
	The definition of the tender packages at the very early stages of the design stages was difficult. Many design addendums were reissued with many variations. This led to time extension and extra budget allocations.	4	80
	The planning and re-planning of the work was an on going process.	3	60
	Too many decisions had to be made with little	3	60

	information available and without seeing the full picture. This added the responsibility on us to produce accurate work packages.		
	It was difficult to properly design all labs since the end user was not available at the time of design. Some labs were designed with 100% redundancy for MEP building services.	3	60
	Defining unit rate costs with the client at tender stage was also difficult due to incomplete design documents. Cost plus approach was the answer but it was costly.	3	60
	Certain tender results were too high because of the risk item involved. This lead to redesigning many work packages.	3	60
	Some work packages and equipment could not be handled by the local manufacturers and suppliers. Many design modifications were made and outsourcing was a must.	4	80
	The desire to meet Platinum LEED target was another challenge that led the client to incur additional cost.	3	60

Comments:

The results show that this consulting firm is well familiar with the D&B project delivery option. This result coincides with the findings of the literature review and the application of D&B internationally. On the question of meeting the schedule and quality level sixty percent (60%) majority of the responses indicated that the project met the established quality level and schedule but certainly not the project budget. The consultant reported that both the client and contractor were very collaborative and contributed to the success of the project. The key reported success areas include:

- The client's determination to resolve all technical matters in order to meet the master Plan issuance deadline for tendering.
- The presence of the client technical and financial teams at the consulting and contracting offices as well as at the site. This close proximity was vital for making rapid decisions and for conducting on-board value engineering.
- The awareness of the parties with the D&B contracting
- The selection of a capable D&B firm to procure the project based on best practice, two-stage award.
- The focus was on getting the project built on time.

The main reported problem areas were:

- Shortage of time for detailed design and construction influenced the design. An element of repetition was introduced in the architectural design.

- The definition of the tender packages at the very early stages of the design stages was difficult. Many design addendums were reissued with many variations. This led to time extension and extra budget allocations.
- Some work packages and equipment could not be handled by the local manufacturers and suppliers. Many design modifications were made and out sourcing was a must.
- Lack of site information led to the redesign of the foundation package soon after the site excavation was completed. This resulted in additional costs to the client. The client carried almost all design and construction risks.

6.6.3 Responses Received from the Contractor Participants.

Arranging interviews and meetings with the contractor was much easier since the author's firm is the D&B contracting firm for this project. Seven direct interviews were conducted with the management, technical and estimating teams. Two interviews were made with the project management department; two interviews with the estimating department colleagues; and three interviews with the site architectural, MEP and structural site engineers. These interviews were conducted between April and September 2009.

Q. 1	**Knowledge and experience with D&B project delivery option.**	**Responses out of (7)**	**%**
	Aware	4	57
	Not Aware	2	29
	Vaguely Aware	1	14
Q. 2	**Your firm's/Institute's experience with D&B option.**	**Responses out of (7)**	**%**
	Aware	5	71
	Not Aware	1	14
	Vaguely Aware	1	14
Q. 3	**Did this D&B project achieve the contract budget targets?**	**Responses out of (7)**	**%**
	Yes	3	43
	No	3	43
	Not sure	1	14
Q. 4	**Did this D&B project achieve the contract schedule?**	**Responses out of (7)**	**%**
	Yes	5	71
	No	1	14
	Not sure	1	14
Q. 5	**Did this D&B project achieve the stipulated quality standards?**	**Responses out of (7)**	**%**
	Yes	5	71
	No	1	14

	Not sure	1	14
Q. 6	**How was the performance of the client during this D&B project?**	**Responses out of (7)**	%
	Very good. Collaborative and proactive. Supportive, met contract payments.	6	86
	Fair. Showed adequate understanding of the scope and approach.	1	14
	Not collaborative and disruptions to the work.	0	0
Q. 7	**How was the performance of the consultant during this D&B project?**	**Responses out of (7)**	%
	Very good. Collaborative. Priorities were clear. Responsive, aware of the contractual challenges.	5	71
	Fair. Aware of the contractual requirements.	2	28
	Not collaborative. Lacks sufficient experience and knowledge with D&B project delivery option.	0	0
Q. 8	**How would you evaluate the performance of the parties – Sub consultants – Sub contractors, suppliers, and manufacturers?**	**Responses out of (7)**	%
	Very good.	3	43
	Fair.	2	28
	Not good	2	28
Q. 9	**Would you recommend the adoption of the D&B project delivery option for future projects?**	**Responses out of (7)**	**%**
	Yes	4	57
	No	2	28
	In specific circumstances	1	14
Q. 10	**In your opinion, what were the critical successful targets achieved on schedule/cost/quality?**	**Responses out of (7)**	**%**
	The team spirit demonstrated by the client, consultant and us the D&B firm.	6	86
	The presence of the client, consultant and contractor at the same place in USA/Europe and on site.	5	71
	Having a listening client who was making rapid decisions to meet the project critical milestones.	3	43
	From the outset tendering for the unit rates and new work packages was transparent and allowed construction to start with little design information.	4	57
	Conducting on-board design reviews, and cost analysis were essential to the success of this project.	4	57
	Long lead items were identified and attended to as a matter of priority.	3	43
	We gave the project managers full authority to push the project through.	3	43
	Risk sharing and risk management procedure was implemented to the benefit for all parties.	4	57
	The work environment was collaborative and participative. Problems were identified and resolved mutually.	4	57
	We were invited to participate in design workshops and encouraged to propose different design and construction solutions.	3	43
	Direct communication, weekly and daily meetings were very effective.	3	43

	The allocation of a dedicated coordination and quality control teams proved their value.	3	43
	The site was managed as four distinct small sub-projects.	4	57
	Conflicts and variation orders were discussed openly and resolved immediately.	4	57
	The use of BIM technology helped resolve many complex design coordination issues.	3	43
	Many site activities were completed without the completion of the shop drawings. Site inspection, shop drawing reviews were running in parallel with construction.	5	71
Q. 11	**In your opinion, what were the major problems encountered in this D&B project which contributed to the delay or increased cost?**	**Responses out of (7)**	**%**
	Pricing the master plan project from the outset was a great challenge and a complicated task.	4	57
	Mobilization was very costly due to the shortage of time.	3	43
	Foundation design was changed due to different soil conditions. This caused some delays and extra costs.	4	57
	Many design assumptions were made with multiple tasks to allow for the unknown.	4	57
	Finding local experienced staff with D&B contracting was extremely difficult.	6	86
	Many delays were encountered due to the design changes and modifications. Many problems were discovered late.	6	86
	The nature of the project mandated that many products, and equipment be brought from abroad. Procurement management was time consuming.	5	71
	Not all the subcontractors were able to meet the contractual specifications and delivery time.	4	57
	Priorities were changing continuously. Motivating the workers to work under additional pressure was difficult.	3	43
	With amount of workload, many staff could not complete their contractual period. Staff turnover was relatively high.	3	43
	Testing and commissioning was done in a rush. Many snag lists items were completed after handing over.	4	57

Comments:

Similar to the responses received from the client's participants, the answers received show that the contractor's staff is knowledgeable with D&B project delivery system. The majority of the responses (71%) indicate that they met the project's quality standard and schedule but they were divided on meeting the budget.

Eighty six percent (86%) majority believe that the client was very collaborative and supportive and seventy one (71%) majority noted that the consultant was as collaborative and supportive. The performance of the local supply chain was rated in the middle with disagreement between the respondents on their performance.

This contractor is in favour of D&B option and fifty seven percent (57%) majority recommend the adoption of D&B option for future projects. These answers did not come as a surprise. The literature review and the responses from the contractors on the survey questionnaire gave similar results. The surveyed contractors believed that D&B option can yield successful results. The key areas that these respondents reported include:

- The team spirit demonstrated by the client, consultant and SOL, the D&B firm.
- The presence of the client technical and financial teams at the consulting and contracting offices as well as at the site. This was vital for making rapid decisions and for conducting on-board value engineering.
- The transparency promoted by the client to facilitate the progress of work.
- Many site activities were accomplished without the completion of the shop drawings. Site inspection, shop drawing reviews were running in parallel with construction.
- Risk sharing and risk management procedure was implemented to the benefit for all parties. The work environment was very collaborative.
- Conflicts and variation orders were and resolved immediately.

The main reported problem areas were:

- Many delays were encountered due to the design changes and modifications.
- Finding local experienced staff with D&B contracting was extremely difficult.
- Some work packages, products, materials and equipment could not be procured by the local manufacturers and suppliers.
- Lack of site information led to the redesign of the foundation package soon after the site excavation was completed. This resulted in additional costs.
- Testing and commissioning were problematic. They started earlier than usual.

6.7 Reported Success and Problem Areas and Lessons learnt

The analysis of the data collected from the interviews of this case study has led to defining the contributing factors to the success of the project, the contributing factors to the failure of the project and the lessons learnt. These are detailed in the following three sections:

1. The main contributors and criteria for success.
1. Problem areas identified.
2. Observations, reporting, and lessons learnt.

6.7.1 Contributors to the Criteria for Success

Following the D&B contractors' prequalification and the project award stage, the client arranged a kick-off meeting on June, 14, 2007. During this group meeting, the client, consultant, and contractor agreed to have common teams physically present where both the design and construction activities are happening. The important duties of the teams were to conduct on- board reviews, attend the technical and financial workshops and expedite the decision making process resolve technical, schedule, procurement, coordination, construction, and cost issues. The contractor's office in Europe was charged with coordinating the IFC documents and managing the design process. They coordinated technical and procurement efforts with the client, consultant's team in USA and the site activities in KSA. The main success points are summarized as follows:

1. ARAMCO selected a two-stage prequalification process at tendering stage. The award of contract was based on technical and commercial evaluation of the D&B contractors. The transparency and risk sharing demonstrated by ARAMCO sent a comforting message to all parties to the contract.
2. Construction activities progressed with full collaboration from the client and the consultant. ARAMCO and the consultant assigned a multi-disciplinary team at the contractor's office in Paris. This team ensured that proper coordination was maintained and the Shop Drawings (SD) produced and coordinated by the contractor's engineering team would meet the quality and budget constraints.
3. In addition, ARAMCO allocated a multidisciplinary team on site to manage the construction. The team also handled contractual matters including
   procuring certain work packages directly for reasons of cost and time saving.
4. The consultant, client and contractor established within their offices in USA, Europe and Jeddah, Saudi Arabia a dedicated multidisciplinary team capable to accelerate the decision making process from the outset. Full construction documents were prepared and reviewed instantly according to the construction priorities. As reported by a senior site engineer from the contractor team:

   > *"On board review allowed the earlier start on site whilst the detailed design work for the project was still being developed. For example, in order to define the extent of excavation, it was necessary to accurately locate the basement walls whilst the detail of the superstructure was not fully developed"*.

5. The integrated team established the critical criteria (Long Lead items) affecting the identified packages. They resolved all the detailed architecture and engineering necessary to ensure that the various tendering dates were maintained and that trouble areas were identified ahead of time.
6. The employment of an independent quality review team on the design side and the allocation of a full time technical coordination team by the contractor to interface between site and design team proved to be worth the cost incurred.
7. The team established a protocol for the exchange of documents, using web-based collaboration tools to facilitate communication called **FDI-NET**). This tool was essential for transmitting electronic files and design information between the various offices, using the same graphics standards. This protocol was then imposed on all the sub consultants working on the project. As a result, the quality of drawings was the same irrespective of their origin.
8. The presence of the client, consultant and contractor at the same place, conducting a series of workshops, resulted in addressing many issues ahead of time. One example was the suggestion of the contractor to replace the piling system proposed by the consultant with stone columns, shown in **Figure 6.6**.

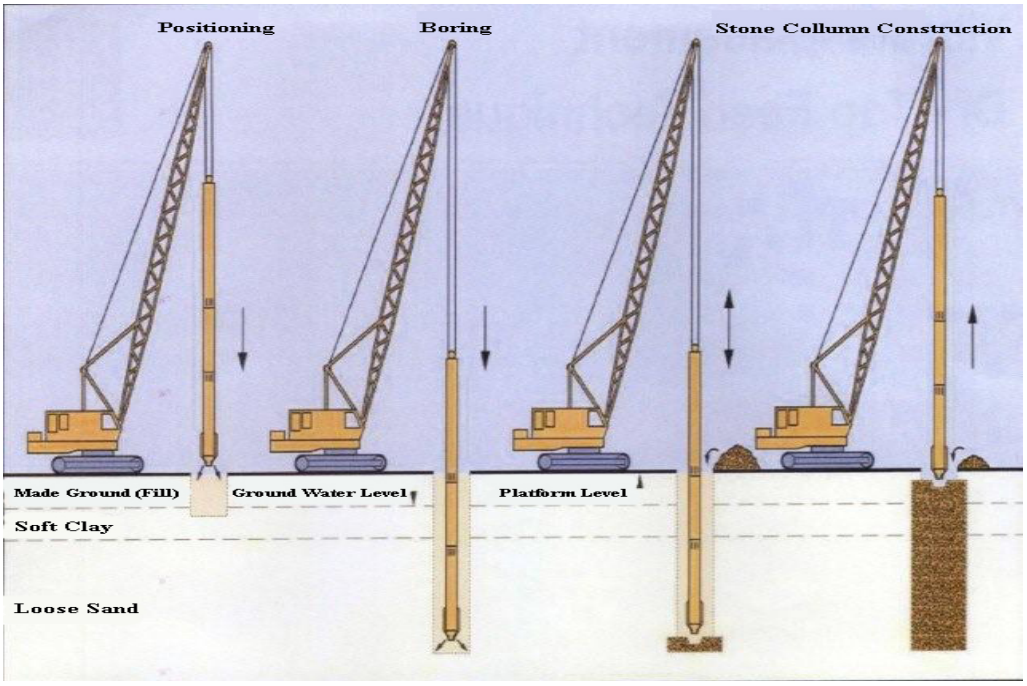


Figure 6.6. Stone Columns Soil Improvement Alternative System Proposed by the Contractor

Source: SOL (with Permission).

this alternative proved to be faster, more economical, and achieved better founding conditions.

Another example was the suggestion to replace part of the stainless steel skylight framing system with a specially treated galvanized framing system. This suggestion also saved time and cost.

1. In order to better manage the site activities the contractor divided the project site into four manageable zones. A dedicated multi-disciplinary team was allocated to manage each zone as an independent project as shown in **Figure 6.7.** Three zones were allocated for the buildings and the fourth was for the external works. The breakdown of the various managerial, contractual and technical departments managing each zone are shown in **Figure 6.8.**
2. On going workshops were scheduled to monitor the activities on site against the agreed schedule. One senior consultant reported:

   "There was no finger pointing during the course of the project. As a problem arise the concerned team members would get together, define the problem, its alternative design solutions or alternative material. Cost related items were always referred to the client who would make a decision within days".

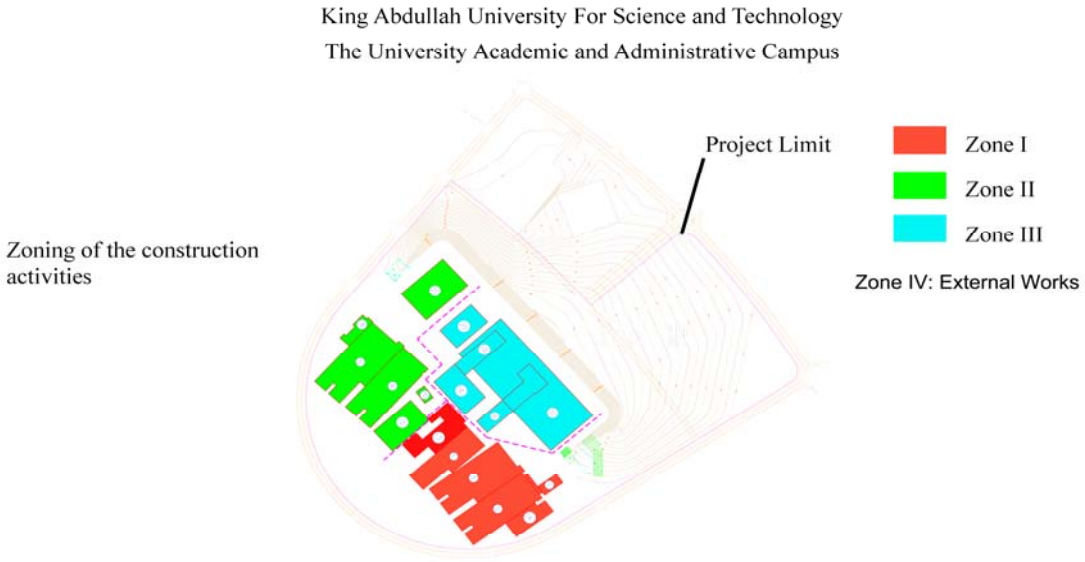


Figure 6.7. Zoning of the Site into Four Construction Activities.

Source: SOL Site (with Permission)

11. The latest engineering design technology was used for designing these buildings for construction. Building Information Modeling (BIM) software were implemented which offered 3D coordination that benefited all project stakeholders across the whole construction project cycle, improving overall performance in time, cost and quality.

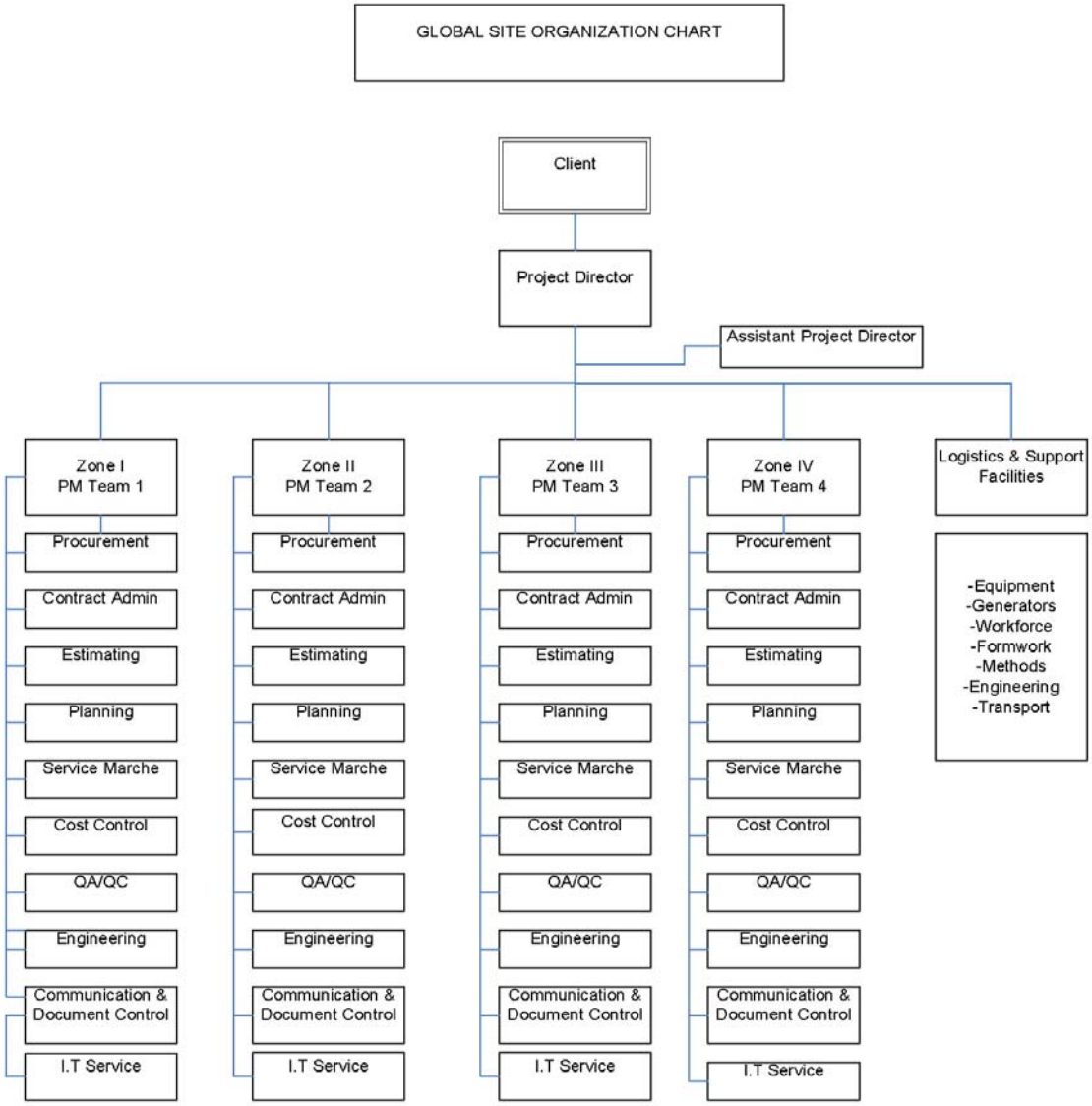


Figure 6.8. Four Independent Construction Teams for Each Zone

12. Agreements on new work, personnel and equipment rates, as well as, variation orders, were resolved within weeks. When a new item appeared on the developed design drawings which was not priced at the tendering stage, the contractor would notify the client and a new item/rate was mutually discussed and agreed. In certain incidences when an agreement on the new rate was not reached, the

contractor would issue this new work to tender and the retuned offers are used to agree on a contractual rate. Similarly, when the actual expenditure of a certain WAR reaches seventy percent (70%) of its agreed budget and the contractor submitted a request for additional budget (over the estimated budget). The contractor would notify the client with this increase and the client would discuss the increase and then agree mutually to a revised WAR claim. As one cost engineer from the contractor estimating team put it:

> *"The point was not so much the validity and cause of the claim; rather, it was a case of mutually considering what is the best and most economical way to solve this situation. There was trust and cooperation from all parties. Construction was going a head without complete drawings".*

13. Decisions regarding design and constructability were needed from day one. Proactive engineering decisions affecting the design were expedited allowing for speed of construction. The team agreed during the regular workshops that most buildings would utilize Pre-Fabricated construction for walls, floors and roofs. The element of repetition was present. However, the consultant was aware of the potential risk of monotony in the design. They offered designs that allowed the speed of construction without negatively affecting the design aesthetics.
14. At the first workshop, for reasons of speed, economy, and saving transportation time, the client and the contractor agreed to build a hollow core factory and two batch plants on site. This measure proved to be very effective since most of the floor slabs were built with Hollow Core slabs.
15. Design and construction decisions were discussed jointly through a series of agreed workshops. These intensive workshops addressed critical design, procurement, cost, schedule and constructability issues. One result from the workshop was the need for raising and suspending the ground slabs and the grade slabs. This design allowed their construction to proceed without building services. Raising the slabs allowed for building services to penetrate at a later date. **Figure 6.9** shows these details. Other issues agreed and resolved in the workshops include:
    - The floor slabs were predominantly made of Hollow Core Prefabricated planks with pre-formed openings to run services as shown in **Figure 6.10.**

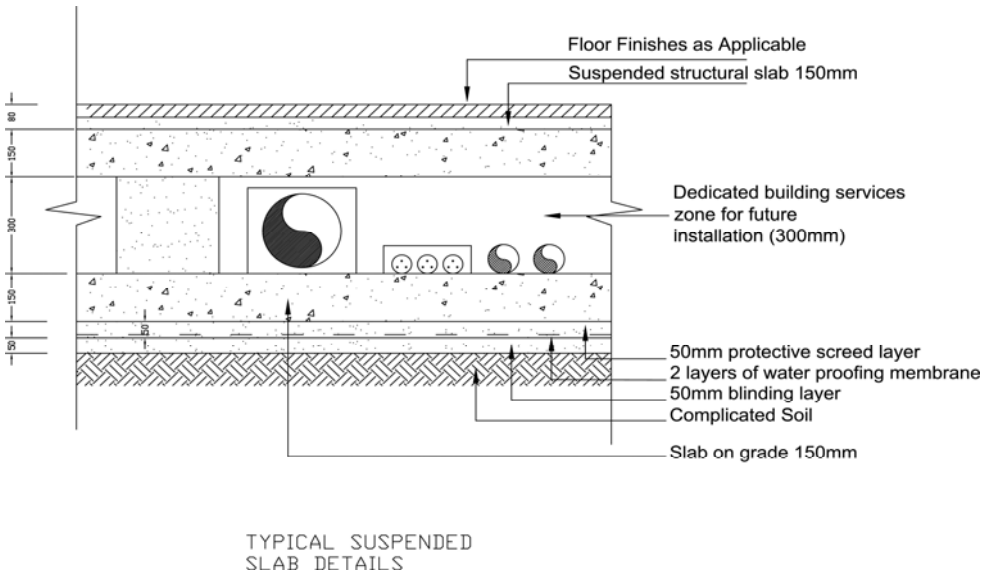


Figure 6.9. Suspended Ground Floor Slab Designed and Constructed with Provisions for Running Services at a Later Stage.

Source: SOL Site (with Permission)

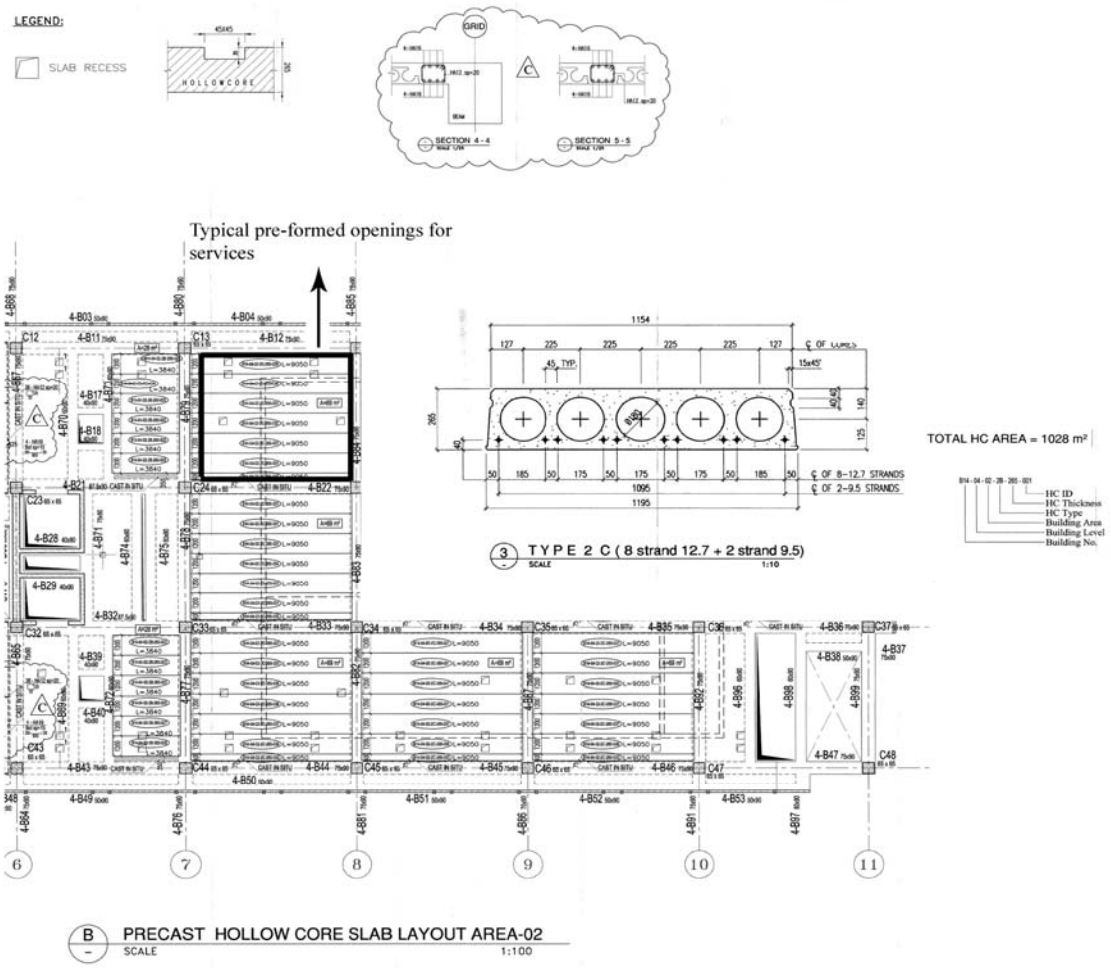


Figure 6.10. Typical Hollow Core Slabs with Preformed Openings for Building Services.

Source: HOK USA (with Permission)

- Major building service routes were agreed before hand to coincide to the greatest extent with these pre-formed openings.
- Pre-cast structural beams were designed with pre-formed openings to allow building services to run though them.
- All special features such as the solar towers and atria roofs were designed in steel, treated as Long Lead Items and delivered to site pre-engineered and ready for installation. **Figure 6.11.** The roofs were designed to have a dual function. First, the main structural beams supporting the cantilevered floors were incorporated so that temporary structural provisions could be built to accelerate the construction of the three floors below without delays. Second, they were designed to shade all Air handling Unites located on the roof immediately above the spaces they service, **Figure 6.12.**

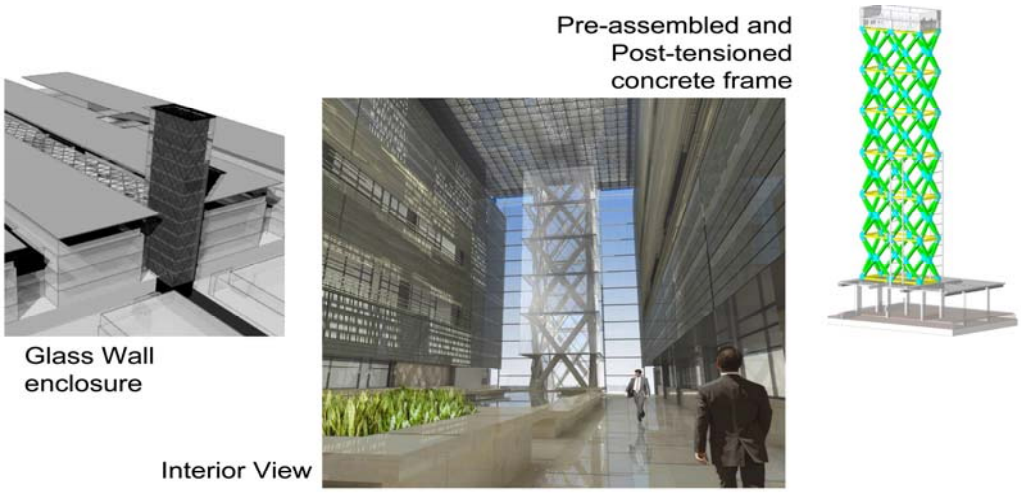


Figure 6.11 Pre-Fabricated Feature Solar Tower Designed as a Pre Engineered Structure for Speed of Delivery.

Source: HOK USA (with Permission)

The contractor site mechanical engineer reported:

> *"We suggested this option to the design team to save time in looking for mechanical space on the floors. This option made it possible to have the machines on the roof and pre-formed openings were coordinated with the Hollow core slabs. The result was speed and ease of installation"*

- Engineering design principles were standardized as much as possible for the following:
  - Structural column grids,
  - Curtain wall system,
  - Staircase lengths, width and finishes,
  - Floor to floor heights and all major items.

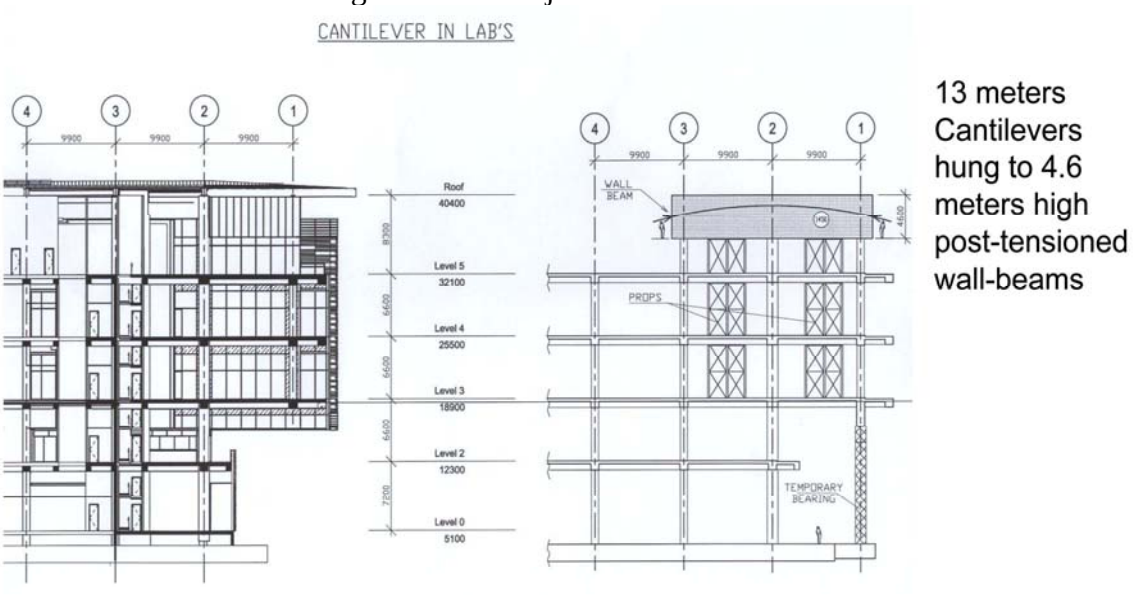


Figure 6.12. Cantilever Wall/Beams at Roof level Designed to Allow Faster Construction at the Floors Below.

Source: SOL site (with Permission)

16 . In addition the same approach was taken for the selection and capacities of the mechanical equipment:

1. Air handling Units, (AHU), ducts, mechanical controls pumps, pipes sizes and material, gate valves.
2. Electrical Panel boards, cable sizes and low current systems.
3. Lifts sizes and capacities, escalators.
4. Wet areas and technical rooms.
5. Architectural products, tiles, glazing units, cladding, doors, windows and ceilings.

17. Building facades were predominantly prefabricated using a non-conventional enclosure system. This avoided the labor intensive laying of CMU walls. This is shown on **Figure 6.13** and **Figure 6.13A.** One design principal explained:

"Speed of procurement and construction was driving the entire process. We asked the contractor to propose the fastest and most economical wall enclosure system and they proposed prefabricated steel frame with manufactured terracotta tiles. The frame is assembled on the ground and lifted to its final position by cranes. The speed these walls were built was remarkable"

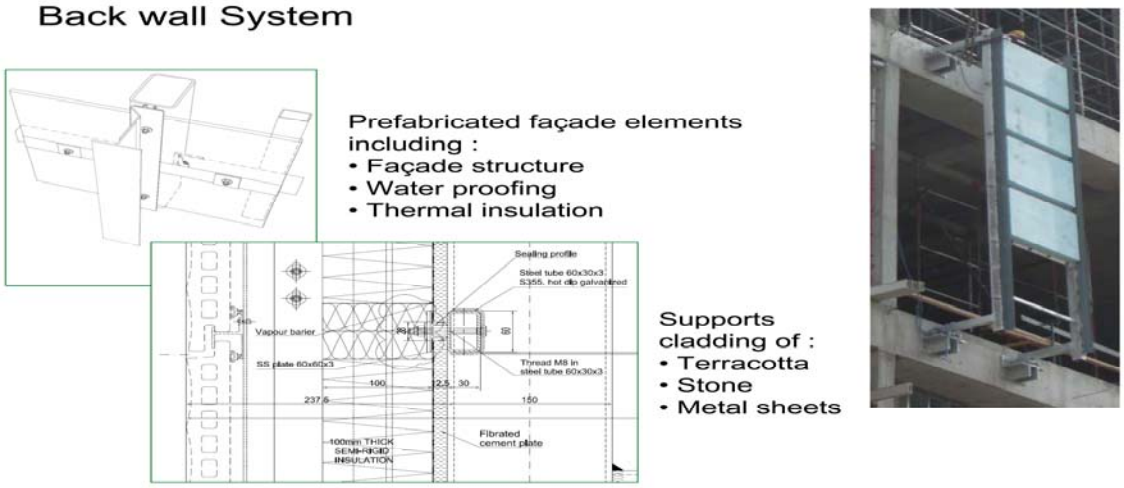


Figure 6.13. Building Facades Details Using Non- Conventional Pre-Fabricated Steel Framing and Terracotta Tiles .

Source: SOL site (with Permission)

18 One major contribution to the success of the project as one senior manager from the client recounted was the close and constructive cooperation between ARAMCO, HOK and OGER since project start, and maintained during execution phase, mainly by:

- Integration of ARAMCO, OI, HOK, and Subcontractors teams at Oger International, Paris office ("One Team, One Place, One Goal")
- *On-going workshops involving all parties whenever needed and wherever recommended (Paris, Thuwal, Houston, Dubai).*
- We developed the system of looking ahead on a six month basis. This allowed the team to plan ahead of schedule, anticipate problems, propose solutions and stay proactive.

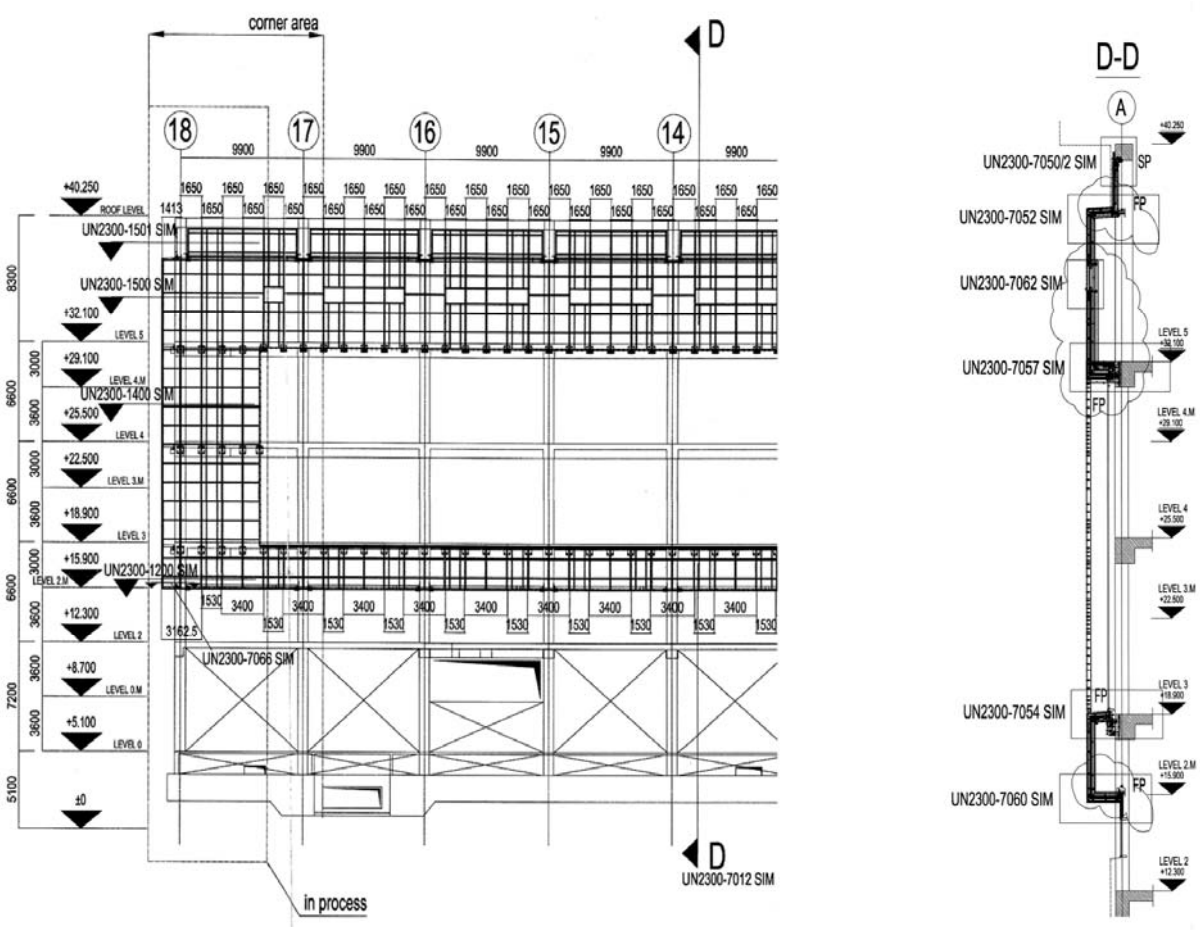


Figure 6.13A. Building Facades Details Using Non- Conventional Pre-Fabricated Steel and Terracotta Tiles .

Source: SOL site (with Permission)

6.7.2 Reported Problem Areas

1. Several problems faced the D&B team from the outset. The aggressive schedule mandated by the contract necessitated the need for more resources across all disciplines from the client, consultant and contractor. These needed resources were mainly senior, experienced individuals with skills to procure D&B projects. Filling this category of professional staff was a major problem that the project stakeholders faced. One senior contractor representative reported:

   "We were ready to approve the fees for these professionals but many new candidate engineers declined the job when they knew the challenges of the schedule. It was a case of finding the right people for the project and not meeting the scale of salaries"

2. Another problem was the response from the local market suppliers and

manufacturers. Many local and international suppliers and manufacturers were ready to respond to a typical fast track, short delivery schedule.

3. KAUST schedule was aggressive and challenging. It involved complex and high quality standards. Many of the suppliers refused to bid the project. A combined technical and procurement team from the consultant and contractor had to meet/visit these suppliers/manufacturers to help solve some technical concerns, explain the specifications, conduct quality assurance and control at the production point. This procedure was necessary for many items such as; the special AHU, Lifts, Pumps, special glass, steel structures, stone material at the quarries, façade material etc.. As one client engineer put it:

   "Sending samples and communicating via e-mails was giving us neither enough assurances nor certainty of delivery. We had to go and see that the products and material were actually being produced on time and to meet the target dates. The end date was fixed and there was no room for delays. It did cost us more than anticipated but that was the price of shorter time"

4. The local construction industry was going through a major unprecedented construction boom. The local factories could not cope with the demand and short supply time mandated by the KAUST project. One way of solving this problem was the offer of a higher down payment premium than usual and a faster, shorter payment process. This increased cost was approved by the client at the beginning, but was stopped when certain critical milestones were met.
5. The Contractor rushed to begin work on site without having a full construction document set of drawings and specifications. Despite having a dedicated coordination team at consultant's and contractor's project bases, many coordination problems still occurred during the construction stage when financial commitments that had been previously established were inadequate. One senior estimator from the contractor's side explained:

   "The risk factor was relatively higher than common practice and the contingencies built in the tender documents were in some case insufficient to off set the final costs. In many incidences the detailed design was returned and revised for simplicity and cost effectiveness"

6. The soil improvement package (with deep piling) was released by the consultant as scheduled. However, performing and completing the piles required three

additional months due to many poor substructure conditions that were encountered. This meant that adjustments were inevitable. A new proposal was devised using stone columns instead of piles. This change in the soil improvement system caused some delays within the schedule.

7. The various structural packages were released to site on schedule but many had coordination problems. The contractor and consultants were making assumptions and counter assumptions. Because of the time constraint, the client agreed to allocate a set budget to cater for any rework and changes on site. This measure, as reported by one engineer from the client's side, could have been avoided if the client had established the project's scope in advance, issued the designers a comprehensive design brief, and allocated enough time for the design to develop.
8. The function and use of only 12 out of 48 laboratory cells were identified with the design information at the design development stage. The remaining 36 labs (Energy, Oceanography, Environmental and Marine to name a few) did not have full design information. Provisions for space and building services requirements were made to cater for "every possible set up and future use with 100% redundancy in building services and flexibility". This measure, as reported by one architect from the consultant team, delayed the project progress and cost the project a higher premium.
9. During the finishing stages, many design changes and alternatives were late in arriving to the site. In addition, the university's academic committee introduced changes requested by the Advisory Group of the faculty, other consultants, and researchers. These changes caused a major slippage in the fast track program and pushed the date of issuing PK4, PK6, PK8, and PK11 by around five weeks each. Recovering this delay caused additional overtime work, increased coordination efforts with the suppliers/manufacturers, some simplification of internal installations, and the substitution of some finishes.
10. Although the project was substantially completed on time with minor delays on completing the external works, and some laboratory fit out, there is a slight delay in the program. The completion of the remaining work will require 3 additional months. **Figure 6.14** shows the comparison between the original schedule for the project per work package and the actual schedule with the additional 3 months. **Table 6.6** shows a summary of the types of problems encountered during the

execution while **Figure 6.15** shows the percentage and magnitude of their occurrence due to the D&B fast track option.

11. Because of the late arrival of certain design packages with the continual updating and refinement to the design the consultant and the contractor submitted a number of claims for additional and abortive work. The mounting pressure on the D&B team from the government to see tangible progress pushed the team to accelerate the fast track procurement and bear all the financial consequences. The total number of variation orders as of June 2009 was around $1.1 billion US Dollars. The project did not meet the established budget.
12. Some design packages had to be resent to the designer due to high bid costs received after tendering. This included the stainless steel frames for the skylights and the work for the solar towers. Some stainless steel frames were redesigned as galvanized structural frames which slowed up the construction process and caused some unexpected delays.
13. Because the pricing was made on a master plan and limited design information, some price rates were proved to be either wrong or did not reflect the true cost based on the detailed design. This has caused many claims and redefinition of the items. An example is the structural columns which were priced as regular columns but turned out to be ten meters tall. This required special scaffolding and moulds.
14. The magnitude of the problems was related to late issuing of detailed drawings and problems related to lack of coordination between disciplines. One site engineer from the contractor stated:

> *"Certainly there were problems related to delays from subcontractors/manufacturers and accidents resulting from delays in production from on site hollow core plant and batch plant. However, Major delays were caused by the missing design information and resolving coordination problems on drawings. Rework was inevitable in many cases."*

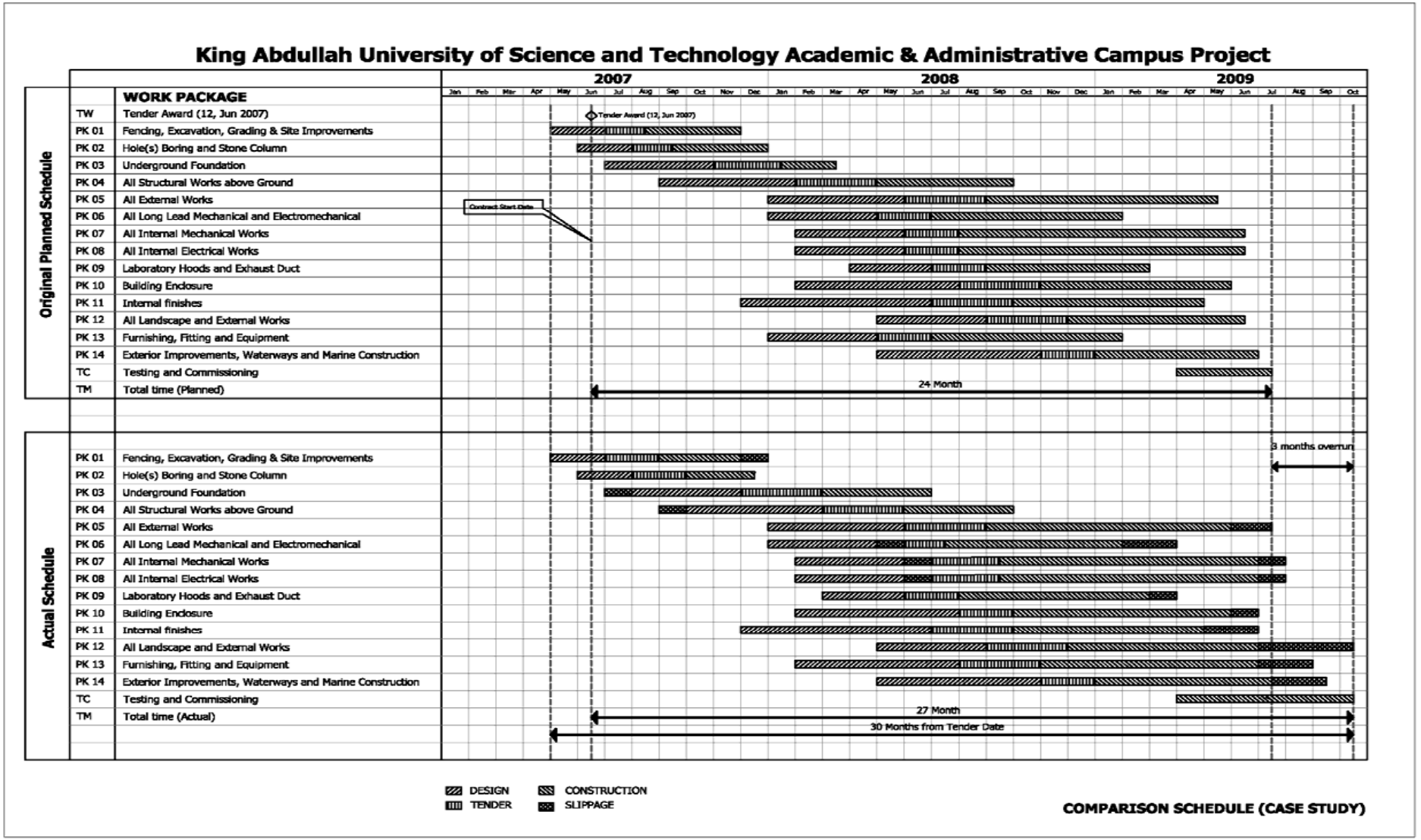


Figure 6.14. Comparison Between the Original Schedule for the Project per Work Package and the Actual Schedule

Table 6.6. The Types of Problems Encountered for Each Work Package and their Frequencies

	ITEM DESCRIPTION - SITE ACTIVITIES	Coordination Problems	Lack of Design Information	Wrong Design Information	Change in Design Brief	Late Issuing of Drawings	Late Client Decision	Late Shop Drawings Approval	Delays from Supplier	Site Accident Site Problems	Cost Problem	Time Impact (Weeks)
PK I	Excavation, Rough Grading and Site Fencing and Soil Improvement											
	Level of raft foundation changed twice		1						1			1
	Sub Total	0	1	0	0	0	0	0	1	0	0	1
PK II	Bore Holes and Stone Columns											
	Piling system changed	1		1			1		1			
	Sub Total	1	0	1	0	0	1	0	1	0	0	0
PK III	Underground Foundation (All Buildings)											
	Reinforcement details issued late	1	1		1	1						1
	Accident on site / Problems with Patch Plant									1		
	Changes in Columns location	1	1	1				1				
	Changes in location of embedded services	1		1				1				
	Many areas put on hold due to lack of design information		1			1			1			
	Tendering stages delays		1	1		1					1	2
	Major rework to construction of building cores											
	Site feed back with design errors	1		1								1
	Delays in issuing shop drawings							1				
	More design changes due to Value Engineering input	1			1						1	
	Sub Total	5	4	4	2	3	0	3	1	1	2	4
PK IV	All Structural works above ground											
	Not all structural drawings were issued on time	1	1	1	1	1		1				3
	Error with beam sizes (precast members)	1		1				1				
	Wrong Information on Mechanical and Electrical drawings (site feed back)		1	1		1					1	
	Openings in structural beam were un-coordinated	1	1					1				2
	Some column sizes were missing / conflict	1	1	1								
	Late issue of Solar tower structural drawings				1	1		1			1	
	Changes in service shaft due to architectural changes	1		1								
	Late issue of cantilever beam structural drawings	1				1		1			1	2
	Late issue of HVAC space requirements	1				1						
	Incomplete drawings on technical floors	1	1				1					
	Late Issue of Labs space requirement		1			1	1					
	Architectural changes to building façade	1			1							
	Client changes to design brief				1		1				1	
	Changes from consultants			1	1		1	1				
	Sub Total	9	6	6	5	6	4	6	0	0	4	7
PK V	All External Structural Works											
	Slippage in issuing tender package		1			1					1	2
	Delays in issuing the parking floors for tender		1			1		1				2
	Delays in issuing marine improvement drawings		1			1	1		1	1		
	Client changes to the brief		1		1		1					
	Accident due to bad weather									1		
	Sub Total	0	4	0	1	3	2	1	1	2	1	4

continue on page 2

Table 6.6. The Types of Problems Encountered for Each Work Package and their Frequencies

	ITEM DESCRIPTION - SITE ACTIVITIES	Coordination Problems	Lack of Design Information	Wrong Design Information	Change in Design Brief	Late Issuing of Drawings	Late Client Decision	Late Shop Drawings Approval	Delays from Supplier	Site Accident Site Problems	Cost Problem	T
PK VI	All Long Lead Mechanical (Lifts, AHU, HVAC controls, Substation, Panel Boards, Atrium, Glass roof, Terracotta tiles, etc..											
	Additional Client Requirements						1		1		1	
	Changes introduced by Value Engineering	1		1			1	1			1	
	Coordination problem (Structural / HVAC)	1		1								
	Coordination problem (Arch'l / ID) Labs	1		1		1						
	Delays shop drawings approval							1				
	Variation order due to changes in design		1	1	1			1			1	
	Variation order due to rework of roof mounted AHU plant		1			1						
	Variation order due to incomplete façade drawings	1	1				1		1			
	Variation order due to addition of façade lightings.		1				1				1	
	Variation orders due to addition of lecture halls		1				1					
	Variation order due to missing details of main library building	1	1			1	1				1	
	Variation order due to missing details of administration buildings.		1	1		1						
	Sub Total	5	7	5	1	4	6	3	2	0	5	
PK VII	All Mechanical works (Chilled water pipes, controls, Pumps etc….)											
	Delays in supply HVAC materials									1	1	
	Missing equipment schedule		1	1			1					
	Delays in issuing Fire and Safety tender package		1			1		1			1	
	Wrong design drawing issued for Tender.	1		1								
	Coordination problem between service shafts	1		1				1				
	Insulation noise criteria incorrect / redesign	1		1		1						
	V. E replacement of given rooms flooring				1		1				1	
	V. E replacement of main Labs finishes.	1					1		1		1	
	Late issue of HVAC pumps / control package for tender		1			1						
	Sub Total	4	3	4	1	3	3	2	1	1	4	
PK VIII	All internal Electrical works. (Cables, Cable trays, Panel boards etc…)											
	Poor coordination between electrical / architecture	1	1	1								
	Poor coordination between I.D/Secutrity Consultant	1	1	1			1					
	Redesign of the lighting system due to high costs.		1	1	1				1		1	
	Delays in panel boards supply.					1		1	1			
	Late issue of electrical cables requirements		1	1							1	
	Sub Total	2	4	4	1	1	1	1	2	0	2	
PK IX	Laboratory Hoods and Exhaust Ducts.											
	Wrong information on drawings (site feedback)	1	1	1		1						
	Delays in issuing shop drawings (Due to brief change)				1	1		1				
	Poor coordination with Elect. / Mech. Exhaust	1		1								
	Sub Total	2	1	2	1	2	0	1	0	0	0	
PK X	Building Enclosure (Curtain wall and Terracotta tiles, Roof Panels)											
	Site feedback with design errors	1		1		1						
	Delay in issuing shop drawings (Due to brief changes)				1	1					1	
	Material supply delays from manufacturers						1					
	Not all façade drawings were issued on time		1			1	1					
	Changes in service shaft due to architectural changes		1	1							1	
	Late issue of HVAC space requirement / revision	1			1	1	1					
	Sub Total	2	2	2	2	4	3	0	0	0	2	

Table 6.6. The Types of Problems Encountered for Each Work Package and their Frequencies

	ITEM DESCRIPTION - SITE ACTIVITIES	Coordination Problems	Lack of Design Information	Wrong Design Information	Change in Design Brief	Late Issuing of Drawings	Late Client Decision	Late Shop Drawings Approval	Delays from Supplier	Site Accident Site Problems	Cost Problem	Time Impact (Weeks)
PK XI	Internal Finishes (Tiles, Partition, Metal works, Ceilings, Paint Signage)											
	Late issue of Labs ceiling layout drawings	1	1			1					1	
	Architectural changes to lecture labs		1		1		1					
	Client changes to the applied Math bldg. layout.	1			1		1				1	
	Changes from the academic consultants			1			1	1	1			
	Variation order from contractor (design changes)		1		1						1	3
	Changes to stone cladding source			1					1	1		3
	Changes to flooring material due to high cost				1					1	1	
	Sub Total	2	3	2	4	1	3	1	2	2	4	6
PK XII	All Landscape works and external works											
	Changes to parking roof garden	1	1				1				1	
	Client changes to main plaza area		1		1	1						
	Client changes to main water garden					1	1				1	2
	Repeated client changes, causing poor coordination	1		1							1	
	Sub Total	2	2	1	1	2	2	0	0	0	3	2
PK XIII	Furnishing, Fitting and Equipment (with ten sub packages)											
	New client requirements during detailed design		1		1		1				1	
	New changes introduce by faculty / research team				1		1	1				2
	Consultant submitted claims for additional fees		1				1					
	Client change administration building layout layout		1		1	1	1	1			1	
	Client changed interior design layout of some offices				1		1	1	1		1	
	Client introduced new design requirements		1								1	
	Change to lab fit out		1				1					
	Major change to labs audio / visual systems.		1	1		1	1				1	
	Sub Total	4	10	3	6	6	11	3	1	0	11	6
PK XIV	Exterior Improvements, Waterways and Marine Work											
	Issuing revised structural drawings	1	1		1	1		1				
	Delays in dredging work		1	1				1		1		3
	New drawings issued to site with revised scope	1		1			1				1	
	New drawings issued to sub consultant for tender			1			1		1			
	More design changes due to Value Engineering		1			1	1				1	
	Sub Total	2	3	3	1	2	3	2	1	1	2	3
		40.00	50.00	37.00	26.00	37.00	39.00	23.00	13.00	7.00	40.00	42.00

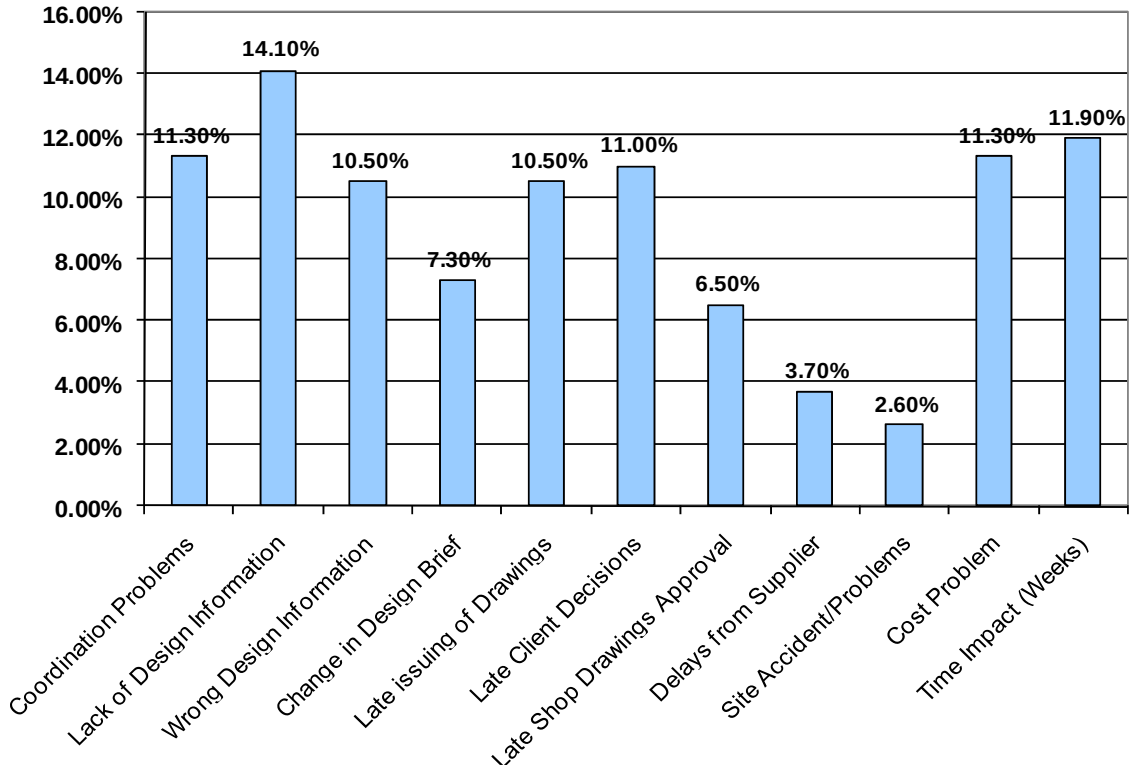


Figure 6.15. The Magnitude and Percentage of Each Problem Category and the Occurrence for Each Work Package.

6.7.3 Observations and Reporting, Lessons Learned

KAUST project was procured using the D&B approach following the approval of the conceptual master plan design stage. D&B contractual arrangements were used but with specific bespoke clauses to suite the specific circumstances of the project.

The construction activities started ahead of the schedule, utilizing incomplete design information and without the approval on all cost unit rates and contractual clauses. The contract and administrative work had to catch up with the site activities. The client's prime objective and paramount concern was developing the project that achieved the completion date. The true financial cost of this decision was never part of the original project cost plan. According to the discussion with the client's cost control manager- in-charge, it was important to the ministry to start site activities and finish the project on time. The presence of the client, consultant and contractor at the same time and place, making rapid decisions, was vital to the project success. Considering the extent of uncertainties and complexity, the project was completed on time, despite the additional

excusable delays due to some unexpected poor soil conditions. This foundation redesign problem stopped the construction for more than

four weeks. The total delay of two months is negligible considering the amount of work performed in a relatively short period of time. The main observations and key points that can be identified and summarized as follows:

- What is significant in this study is the role of the client as the contributor to the success of the project.
- The absence of complete design documents, the number of design changes introduced during the construction stage, and the changes in the client's priorities did not lead to a significant time overrun nor a drop in quality to the project. The element of "Trust" between all parties to the contract was present from day one. Given the level of uncertainties, the client applied contractual conditions which were perceived as being fair and all parties were working within a Win-Win environment.
- The presence of ARAMCO's staff in the consultant and contractors' bases was very effective and saved tremendous time.
- The mechanism adopted by ARAMCO for approving the work authorization release (WAR) was effective and provided a measure to monitor cost increase and cost control. All parties knew the ceiling of spending and ARAMCO defined the limits by which they had to intervene to curb cost.
- The contractor's selection and project award process was based on best practices and track record.
- Rapid decision making and direct communication were key drivers in keeping the work flowing. Investment in good communication system for exchange of design information was very effective for the success of the project.
- Design for constructability was built in the design process.
- Problem areas were brought to surface and not hidden away. Solutions were sought by all team members since they all had a shared objective.
- Budget and cost control was a major concern. Designers and contractors formed a committee to monitor cost overruns, new rates and the resolution of claims when they arise. The focus remained on getting the job done.

- Finding experienced staff was a major concern. This cost the project some additional expense and delays.
- The local supply chain was not up to speed with the requirements of this D&B contract. The local manufacturing industry needed to perform better as many missed opportunities were lost.
- The project exceeded the allocated budget by a remarkable amount. This was partly because the client had little time to review tender proposals, prices and negotiate the offers. Some work packages were awarded with prices above market rates.
- Most of the construction risk items were shifted to ARAMCO. Cost plus contract was more in favor of the D&B contractor and the consultant.
- The project did not benefit from the value engineering exercise. The consultant had time to validate the technical aspects of the project and did not have time to suggest areas of savings for doing the same for less.
- The handing over formalities and process has taken more time that anticipated and exceeded the original established duration by three times.
- Many laboratories were not fitted out within the time schedule.

One lesson learnt is that the choice to move to D&B option and fast track is certainly justified when all the necessary ingredients are properly in place and the necessary expertise and design information is ready. However, the absence of these two key ingredients could be disastrous. The D&B project delivery option will not be a remedy for this situation.

Another lesson is that the selection of the competent contractor is as important as the selection of the project delivery option. Experience and track record will prove their value under such extreme requirements as seen on the KAUST project. Finally, the team spirit established by the client and the commitment of all parties to work together in a collaborative and participative manner in order to deliver the project was essential to ensure certainty of delivery.

6.8 Facts and Figures; Academic and Administrative Campus Project

- Site Area 500,000 sqm
- Built up Area 495,063 sqm
- Students population Single 1220

- Students population Families 3666
- Faculty families 3444
- First year enrolment 340 students
- Students nationalities 45
- Administration 600
- Professional Staff 1220
- Support Staff 560
- Total Expected Occupants on Campus 10,500

Earthwork and Structural Work

- 475,000 m² Buildings Floor Area
- 1,500,000 m3 Backfill
- 221,000 lm Stone Columns (37,500 Units)
- 470,000 m3 Cast in Situ Concrete
- 172,000 m² Hollow Core Slabs
- 100,000 Tons Steel Reinforcement
- 8,000 Tons Steel Structure

Enclosure, MEP, and Interior

- 210,000 m2 Facades Including :
- 70,000 m2 Curtain walls
- 90,000 m2 Terracotta
- 50,000 m2 Stone cladding
- 110,000 m2 Roofing
- 217,000 m2 Interior Partitions
- 7,000 Doors
- 76 Elevators (6 freight elevators)
- 186 Air Handling Units (Total capacity of 18,500 Tons)
- 110,000 lm HVAC Ducts
- 2,200 lm 900 mm dia. Chilled Water Piping
- 23,000 lm Medium Voltage Cables
- 37 Substations (Total capacity of 128,100 KVA)
- Specialist consultants (43)

Figures 6.16 and 6.17 provide some indications regarding the planned resources committed to the project over the PLC, the rate that concrete pouring was taking place and the rate of producing and delivering the Hollow Core slabs to the building. The project mandated the presence of the required work force and plant on site shortly after contract award. One year after contract award the contractor had more than 14,000 men on site. The hollow core slab factory and batching plant which were built on site to support and cover for any failure of the hollow core suppliers was essential to ensure the continuity of the supply. This measure was effective and covered for any default by the hollow core and ready mix suppliers.

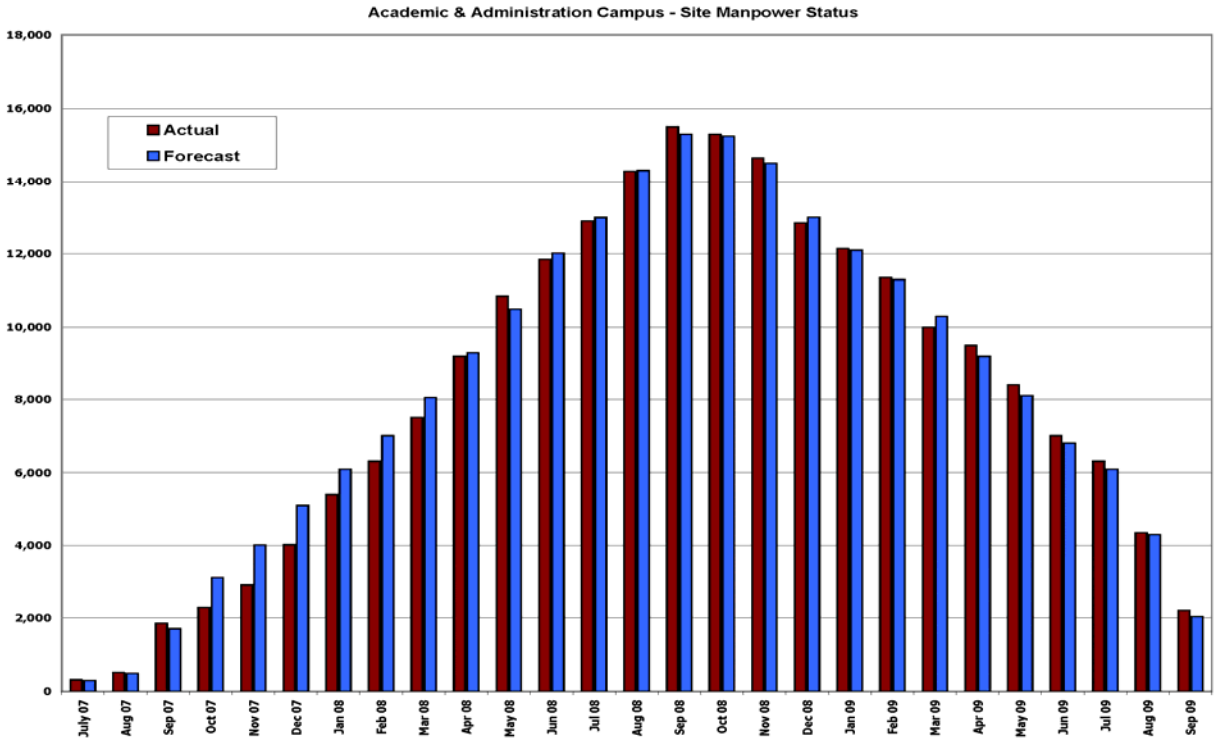


Figure 6.17. Magnitude of Cast- In- Situ Concrete Rate Graph for the Project

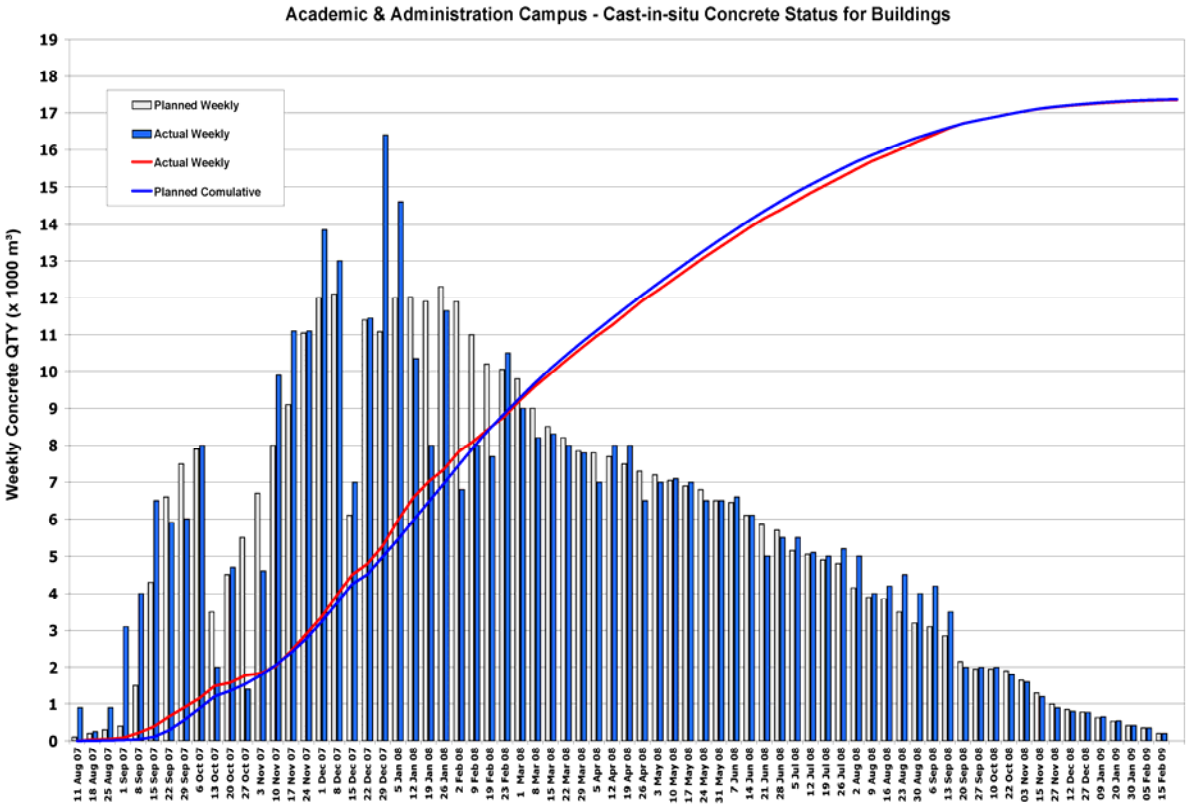


Figure 6.16. Manpower Graph for the Project Covering the In Kingdom Contract

6.9 Summary

This chapter presented a case study of (KAUST) project built in the Western region of the Kingdom of Saudi Arabia which was delivered using the D&B project delivery system. The priorities of the client were clear from the outset. The project targeted and received the platinum LEED certification. The project was completed to the client's satisfaction. It met the quality, time targets but ran over budget. The interviews and site visits revealed that the underlying success factors were the shared knowledge with D&B option, the vision and common objectives of the entire team and the determination of the client to drive this process with a cooperative and participative environment. The key contributors to the success element included:

- The contractual selection process was based on technical, as well as, commercial qualifications, fees and prices were agreed before hand in a participative and transparent work environment, claims, variation orders were never an obstacle for advancing the construction. There was no place for disputes and conflicts, the use of BIM technology helped in clarifying many complicated aspects of the design.

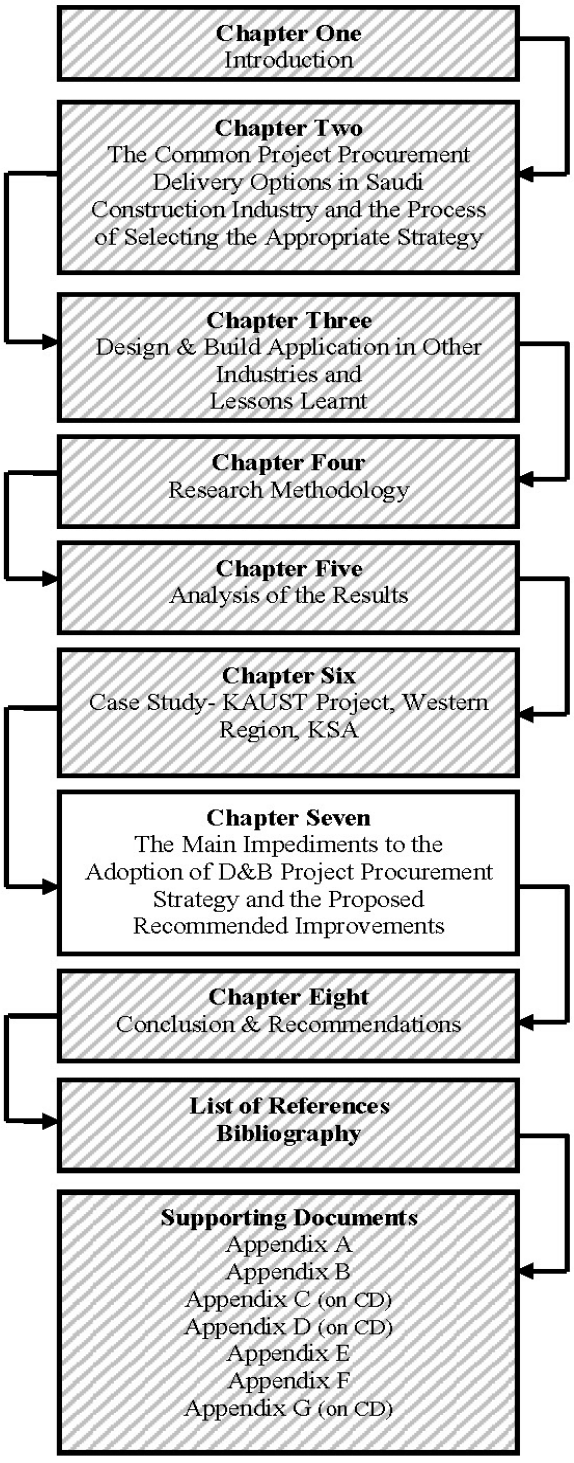
On the other hand some problems and draw backs included:

- Finding qualified and experienced personnel with D&B project delivery approach was difficult and resulted in a heavy financial implication, the local industry suppliers and manufacturers were under pressure to cope with such aggressive deadlines, the client incurred a higher cost than originally budgeted despite some tighter cost control, increased number of variation orders due to design changes and modifications.

The findings confirmed that the quality of the project did not suffer to any significant extent but cost overruns were reported. The project suffered two months delay. This delay was considered insignificant. The client's and contractor's managers confirmed that the prospect for D&B approach in the local construction sector is bright and the Saudi construction industry will move towards procuring more projects along this project delivery technique. The next chapter will present the main findings of this study, the impediments to the adoption of D&B project delivery systems and their proposed solutions.

Chapter VII

The Main Impediments to the Adoption of the D&B Project Procurement Strategy and the Proposed Recommended Improvements.



7.1 Introduction

This chapter presents the findings of the direct interviews and surveys. It also records the case study evaluations. The participants represent consulting and contracting firms, public and private sectors agencies, various other manufacturers, real estate market evaluators and insurance firms. The main impediments to the adoption of the D&B project procurement strategy are analyzed, interpreted and presented.

Recommendations to attain the adoption of D&B procurement strategy are presented in a table format. A preliminary working model presents an effective approach for implementing the D&B process from the definition phase to the construction phase. The recommendations represent the suggestions proposed by the survey respondents to increase the awareness of the local construction industry stakeholders regarding the D&B project delivery option. They show the means to improve performance of the Saudi construction industry. The role of the public sector is discussed. Certain suggestions are directed at the government to assume the role of exploring the potential of this project procurement strategy for the Saudi construction industry.

7.2 The Main Impediments Identified and the Proposed Recommended Improvements.

Results of the survey demonstrate a remarkable difference between the perception and practice. The D&B project procurement strategy has a wide difference of opinion regarding its understanding and application. Consulting and contracting firms are generally aware of the D&B project delivery option. It is used on different types and sizes of projects. Clients have different reasons for using D&B approach and seek various desired outcome from this project delivery option. However, consulting and contracting firms indicated that they prefer to work for special and known clients who will provide them agreeable contractual and budget terms. Surprisingly, consulting firms are more involved with the D&B approach than contracting firms.

Consulting and contracting firms have encountered several problems when procuring D&B projects. Lack of trained staff, lack of financial compensation, challenges to meet the desired standard of work, unavoidable amount of rework, difficulties in understanding of the client's requirements were among the main problems reported. Consulting firms believe that the traditional D.B.B project delivery is preferred by the local construction industry stakeholders because they are familiar with it. They understand the contractual duties, and obligations. The insurance liabilities are well

defined. Contracting firms, on the other hand, reported that cultural reasons, contractual terms, and the lack of available D&B firms are the primary reasons that make the traditional D.B.B procurement more attractive. D&B option is perceived to have many coordination issues and may not yield a high quality project.

The analysis of the results revealed that the consulting and contracting firms agreed that the D&B project delivery option will continue to be more in demand in the future. The respondents proposed improvements to make D&B project delivery option more attractive. These included:

- Having a dedicated internal organizational team for procuring D&B projects.
- Develop better understanding of the scope of work.
- Having in-house expertise with D&B option.
- The contract award process must be based on best practice and best value for the project. Technical and commercial capabilities as well as track record and reputation must be considered before contract award.
- Revise contract terms to have shared risk distribution.
- Agree fair contractual terms.
- Encourage the D&B firm to propose design and construction alternatives.
- The involvement of the D&B party from the project outset.

The survey results of the other seven sectors of the construction industry regarding their knowledge of the D&B strategy also varied. The level of their awareness with the D&B option also varied remarkably. When and how these stakeholders apply the D&B project procurement option for different types of projects was noted. Speed, complexity of the project, and reduced costs were the main reasons for selecting this project delivery strategy. To many in the public sector and to more than half of the government authority clients, D&B project delivery option presented higher risks of delay, cost overruns and adversarial relationships.

Real estate developers and private sector clients often use D&B option on their projects. The types and nature of impediments that these groups found included the lack of general knowledge, expertise, suitable contracts, and management skills to handle D&B projects. These seven sectors of the Saudi construction industry

proposed improvements that would make D&B project delivery option more attractive. They include:

- Increase awareness regarding D&B project procurement delivery option.
- The appointment of an independent cost engineer to approve payments.
- Increase staff training to become familiar with D&B project delivery option.
- Revise government contract terms to allow for procuring projects using D&B option.
- Using a two-stage process for pre-qualifying and awarding D&B contracts based on best practice.
- The insurance terms and liability coverage fees must be reconsidered to facilitate the adoption of D&B firms.
- There is a need within the Saudi construction industry to have more D&B firms.
- Clients have to make rapid decisions and meet their financial costs.

Some of the D&B related problems described in the literature review and indicated below were familiar to the majority of the sample. These include:

- Missing design information,
- Ineffective client's participation into making decisions,
- Lack of general awareness with D&B project procurement option,
- Additional costs and costs overrun,
- Continuous rework and taking additional risks

The analysis revealed the obvious lack of proper definition and understanding of the principles concerning D&B project procurement strategy. In particular, the technical framework that regulates its use and proper application is not comprehended. Many respondents are misguided and do not appear to grasp the true meaning of D&B procurement option. They simply feel safer following the D.B.B option. After analyzing the surveys, and after the interpretation of the responses, and after computing the frequencies of the responses, ten categories of impediments were identified. These impediments prevent the adoption of the D&B project procurement option. They are as follows:

7.2.1 Lack of knowledge and understanding of the D&B principles and procedures.

7.2.2 Cultural impediments, mainly due to mistrust between clients and contractors.

7.2.3 Slow regulatory procedures and the absence of phased permits.

7.2.4 Organizational and contractual impediments.

7.2.5 Fear of inferior and unsatisfactory quality of works.

7.2.6 The current inappropriate process of selecting and awarding the D&B projects.

7.2.7 Lack of available medium and small size D&B contracting firms.

7.2.8 The perceived risk of no cost certainty, delays, litigious attitude that often leads to adversarial relationships.

7.2.9 Government contract documents are based on the procuring D.B.B option.

7.2.10 The missing role of the government in taking the lead for exploring the benefits of the D&B project procurement strategy.

Each of the above categories includes underlying layers of pertinent problems. All are of a similar type and nature. The interpretation of the above ten impediments and the proposed recommendations to overcome these impediments are as follows:

7.2.1 Lack of Knowledge and Understanding of the D&B Project Procurement Strategy.

This category covers impediments related to lack of knowledge and awareness with the principles of the D&B project procurement strategy. The majority of the research sample was found to be aware of the D&B project procurement strategy. The analysis of their results revealed that over sixty percent (60%) of the Public sector clients and government authorities prefer the traditional D.B.B option. Moreover, eighty two percent (82%) of these two sectors reported that they choose the traditional D.B.B procurement option because of familiarity. It exposes them to less construction risks. They are unfamiliar with D&B application and procedures. One engineer from one of the government authorities said:

> *"When we decide on D&B project for a particular project, we hold our breath. We need to know more about this project delivery option, as we are considering it for more projects"*

Consulting and contracting firms believe with a fifty five percent (55%) majority that their clients are unaware of the D&B option. As one contractor put it:

> *"D&B project procurement option is a mystery to many public and private sector clients. Many are not familiar with the existence of a project procurement selection system to guide them for choosing the optimum project procurement strategy"*

Another quantity surveyor from one consulting firm noted:

> *"Many private sector clients do not or can not prepare sufficient bidding documents that enable D&B firms to submit a competitive bid. Many changes and variation orders appear during the construction stage. This has negatively impacted the application of D&B option"*.

Clients are also found unaware of the additional cost associated with D&B projects. Collectively, over sixty five percent (65%) of the consulting and contracting firms supported this finding. The Saudi construction industry seems to be lagging when it comes to using the D&B product delivery option. The private sector and government authorities' clients are not contributing enough to the improvement of this option. The public sector is not setting the good example of encouraging the proper and effective implementation of this much needed option. D&B clients, on the other hand, must acknowledge that by demanding D&B procurement strategy, their contractual obligations increase. They are expected to make timely decisions, or accept the risk and cost of delays. Cost can be minimized if the clients know what they want and the consultant respects the cost plan.

Finally, the local insurance firms acknowledged that higher premiums for D&B projects are charged due to the potential for claims caused by unclear and inaccurate scopes of the work. Clients leave all risks with the D&B entity. This significantly increases the cost of the insurance policy which defers clients from using this option. While there is a general understanding about the D&B project delivery option within the local construction industry, some local suppliers and manufacturers can not meet certain milestone dates to assist the D&B process.

The above results are confirmed in the literature review. Amjad (1998) stated that one of the reasons for the dominance of the traditional D.B.B option is that the lack of a trained D&B professionals and D&B project managers. Jaweed (2004) also

found out that many Saudi construction industry clients do not use an appropriate model for selecting the optimum project procurement strategy for their projects. Jergeas and Fahmi (2006) found out that lack of understanding the D&B project delivery process is the main reason for the gap between owners' expectations and the deliverables at the end of the project.

The proposed recommendations to overcome these impediments must focus on increasing the public's awareness regarding D&B project delivery option. The government needs to assume the role of defining the principles and framework of the D&B procurement option. More research and case studies are needed to raise the general public's understanding of this project delivery strategy.

The information gained from the case study results showed that there is a general understanding about D&B option within the local construction industry. The client and the D&B firm planned and completed the project on time and to the stipulated quality standards. **Table 7.1** summarizes the current impediments related to this category and the proposed recommendations.

7.2.2 Cultural Impediments.

This category covers impediments related to D&B as perceived by a number of local industry clients. The interpretation of these results revealed disturbing facts. Over seventy- five percent (75%) of consulting firms and ninety percent (90%) of the contracting firms reported that cultural reasons and mistrust impede the adoption of D&B project procurement option. As one manager from a contracting firm put it:

> *"We can not apply the Western work relationship model to consultants and contractors in Saudi Arabia. Contractors are accused of being interested in making quick profit only. This is not true. We also seek to build a sound reputation and a client base. There is a lack of trust between clients and contractors in the Saudi construction industry"*.

Moreover, about sixty-six percent (66%) of the public sector clients, and fifty percent (50%) of the real-state developers, as well as, seventy-five percent (75%) of the insurance and financial market evaluators stated that cultural barriers are the main impediments to the adoption of D&B project procurement option.

Table 7.1 Lack of Knowledge and Understanding of the D&B project Procurement Strategy and the Proposed Recommendations.

I – Lack of Knowledge and Understanding of the D&B Project Procurement Strategy		
Current Impediments		**Proposed Recommended Improvements**
1. There is an obvious lack of understanding regarding the principles and procedures of D&B project strategy application.		There is a need for a joint effort led by the local order of engineering committee, local universities and professional institutes to increase the level of awareness with this project delivery option.
2. No clear framework for the local construction industry stakeholders to follow.		More publication, conferences, exhibitions and focused research is needed to raise the level of understanding of the local industry stakeholders regarding the D&B project procurement option.
3. There is a lack of trained and experienced D&B professional and medium sized D&B contracting firms capable to manage D&B projects.		Continuous and focused training in project management and construction management is the key to having more staff experienced in procuring D&B projects.
4. Not many clients can prepare sufficient and accurate D&B bidding documents, decide on the level of the design drawings to be issued to the D&B entity, how to approve the progress payments, how to define the work packages and agree on the division of liabilities and responsibilities.		Employing an independent consulting firm to prepare and manage the RFP scope of works documents is a step towards resolving this problem. This firm can also define the boundaries of the D&B work packages in terms of their priorities and site needs.
5. D&B project procurement strategy is not well institutionalized. Many local industry stakeholders require explanation and procedures to follow in order to establish when and how procure their projects using the D&B project delivery option.		The government is invited to sponsor research and conferences to discuss the benefits of this project procurement option. Sponsoring case study research and benchmarking the application of this project delivery option would provide some insight into the D&B strategy. Speakers must be invited to discuss these relevant topics openly.
6. There is no well established legal framework that defines the rights of the parties to this delivery technique.		This is where the government is expected to define the principles of this project procurement strategy, set the rules and procedures and legal rights for the parties engaged in D&B contract.
7. There is a misconception that D&B procurement system can only be managed by large D&B firms. Small and medium size firms cannot and do not have the capabilities to handle D&B projects due to the increased cost associated with starting the process and managing the supply chain.		This misguided concept can be resolved by studying relevant case studies featuring completed D&B projects by medium size firm within Saudi Arabia and in Gulf. Focusing on the appropriate process and planning is the key and not only the choice of the procurement system.

The senior analyst from one of the two insurance firms interviewed explained:

> *"The main suggestion to improve the popularity of D&B option is to have a new generation of clients, contractors and consultants start fresh with D&B contracting on solid ground without fear and mistrust"*.

The results showed that consulting clients avoid working with contractors under D&B procurement option for several reasons. These include:

- Consulting firms feel that their status diminishes when working for a D&B contractor. They are treated as subcontractors.
- They are not always party to the preparation of the tender documents.
- Their views are not always considered.
- They do not get the opportunity to meet and discuss the project with the client, since the contracting party seeks this role.
- They avoid having a decennial insurance policy. This ties them to the contractor who assumes this responsibility.
- Their design fees are not proportionate with the level of risk they assume.
- They do not stay involved with the project from start to finish.
- The majority of the local D&B clients are not well versed with the D&B delivery option. Therefore, they do not appreciate the special requirements mandated by the project delivery team.

The above concerns explain why fifty percent (50%) of the consulting firms favor the D.B.B option. The contracting firms' respondents voiced similar concerns. They believe the D&B option is unpopular for the following reasons:

- Consulting firms avoid working with contracting firms.
- Lack of trained professional consultants capable of working with D&B projects.
- The local supply chain can not always support rushed and complex projects.
- Many D&B clients are only interested in the first price. They do not recognize the value of variation orders and changes.
- D&B clients shift all design and construction risks to the D&B entity.

The results from three public sector clients and two government authorities showed comparable views. They indicated that D&B project delivery option is only valid for

rushed and complex projects. Otherwise, it should be avoided. About forty five percent (45%) of the responses from the public sector clients believe that D&B contractors take advantage of the time pressure and manipulate the contract to their advantage.

Two respondents from the government authorities noted that D&B option encourages the design firms to cater to the interests of the contractor, at the expense of the project interests. To overcome these concerns, trust and understanding between clients, consultants and contractors must be fostered. This is equally important for consulting and contracting firms. Sponsored conferences and seminars will facilitate this. Problem areas must be identified, discussed openly, and eliminated. **Table 7.2** summarizes the current impediments related to this category and the proposed recommendations.

7.2.3 Regulatory Procedures and Absence of Phased Permits.

This category covers impediments related to the issuance of planning approval and building permits. The analysis of the results suggest that the D&B projects clients and contracting entities face many obstacles when securing planning and building approvals. This was confirmed by seventy three percent (73%) of the contracting firms and fifty percent (50%) of the government authorities' clients. The structural engineer from one of the D&B consulting firms pointed out:

> *"Local authorities have not changed the current planning and building rules to allow phased design approval process and phased construction approval process. This is one of the impediments to the adoption of D&B option"*

Some of the impediments that were derived from the analysis of the results cover the following areas:

- There are no clear guidelines that define and govern the technical requirements needed for the local authorities review and approval of D&B projects.

Table 7.2 Cultural Impediments and the Proposed Recommendations

II – Cultural Impediments		
Current Impediments		**Proposed Recommended Improvements**
1. Consulting firms do not prefer to work with contracting firms. They loose their status and become subcontractors.		Establishing long term relationships or partnering arrangement on long term basis between consulting and contracting firms will help remove these barriers.
2. Contracting firms prefer to lead the D&B contract and be the prime owner of the D&B contract. They control budget and schedule. This deters consulting firms from partnering with them.		Contracting firms must treat the consulting firms as partners and engage them in all major decisions (commercial and technical) throughout the project. Consultants must feel that their opinion is respected. They also must work to meet the project's budget and schedule.
3. Many industry clients believe that D&B contracting yields corruption and unjustified cost increases. Consulting and contracting firms must be separated for the interest of the project.		This area requires collaborative efforts at all levels from clients, contracting and consulting firms. This serious problem hits at the heart the business relationships. The solution requires direct dialogue and some transparency while preparing the project cost. One solution is to encourage clients to nominate their D&B consultants.
4. There is a common belief that many D&B contracting firms offer this project delivery option to win the contract. The actual implementation of the contract becomes litigious and full of claims. It leads to adversarial relationships.		This is where the two-stage prequalification becomes a must. The evaluation process which is based on track record, reputation and capabilities will solve this problem.
5. The lack of trust between clients and D&B contracting firms is translated into shifting most of the design and construction risk to the D&B entity.		The D&B contracts must be fair and based on good industry practice. Risks shall be shared and given to the party best capable to handle them. Contract clauses must eliminate biased and adversarial clauses and encourage fair and balanced share of risks.

- Local authorities insist on having the full preliminary design documents presented in their entirety in order to grant building approval. This shall include sufficient design data that D&B firms do not always supply.
- Local authorities require detailed design drawings in order to grant building approval. Many D&B projects advance with design from bottom up without having the full structural design and MEP detailed design.

Local authorities, however, pointed out that many D&B project owners change the building design following their issuance of the building permit. They argued that this practice is the cause of many disputes and conflicts. Over sixty five percent (65%) majority of the contracting firms complained that the design and permitting review process is too slow. It does not follow their sequence and priorities of the construction. Many disputes occur.

The suggested improvements must focus on a working framework and guidelines established by the local authorities. The guidelines need to properly define the requirements for submitting D&B documents for approval. These guidelines must address the following requirements:

- The list and details of design documents required for approval by the local authorities.
- The level of design information contained in these documents.
- The regulations and procedures required to be followed by the D&B firms for each stage of the design.
- The guarantee and assurance by the D&B entity of the full compliance with the established regulations and procedures.
- The possible mechanism proposed by the local authorities to facilitate phased approvals.

Table 7.3 summarizes the current impediments related to this category and the proposed recommendations.

Table 7.3 Regulatory Procedures and the Absence of Phased Permits Impediments and the Proposed Recommendations.

III – Regulatory Procedures and Absence of Phased Permits.		
Current Impediments		**Proposed Recommended Improvements**
1. There are no clear guidelines that define and govern the technical requirements needed for the local authorities review and approval of D&B projects.		The local approving authorities are invited to address this problem and publish the detailed guidelines and regulations that define all technical and supporting documents required to grant a planning and building permit.
2. Local authorities request the full preliminary design documents be presented for them to review in order to grand preliminary planning approval. This request is not always possible in D&B projects since it delays the construction process.		Adequate time must be given to the D&B entity to complete and submit the essential design documents at this early stage of the PLC. This is important to ensure that the submitted D&B project design documents fully comply with the established building rules and regulations. Improvements are needed in defining the minimum design information requirements and establishing a faster process for the review of D&B projects.
3. Local authorities require detailed design drawings to grant building approval. Many D&B projects advance with the design from bottom (Foundation) up without having the full structural design and MEP detailed design.		There must be a system that allows the review of essential design packages following the approval of the preliminary design stage. The project can be broken into various phases and packages submitted for review and approval. These work phases must be defined, planned for and agreed upon with the local authorities from the start of the D&B project.
4. There is no mechanism proposed by the local authorities to facilitate phased approvals. The absence of this mechanism is delaying the D&B projects.		This is where the local authorities must in collaboration with the consulting and contracting firms define a workable mechanism and set the rules and procedures for the parties engaged in D&B projects to follow. This phase requires the contribution of all stakeholders involved in the local construction industry.

7.2.4 Organizational and Contractual Impediments.

This category covers impediments related to procuring D&B projects on the design and construction process. It deals with issues related to the structure of the project team, developing fair contractual arrangements and planning the flow of design information to site. The findings demonstrated that there is a lack of experienced D&B firms who are capable of managing D&B projects. Consulting and contracting firms revealed with an over eighty percent (80%) majority that the failure of many D&B projects can be attributed to the lack of qualified staff. One manger from the contracting firm reported:

> *"We believe that D&B contracting requires a new mind set, otherwise organizational problems are unavoidable. This problem cannot be resolved overnight"*

The local authorities focus group interview confirmed the problem. The design and site management team must be capable of planning, designing, procuring, constructing and handing over the D&B projects. Consulting and contracting firms are not necessarily allocating a dedicated, experienced team to focus on this complex and demanding management technique. The architect from the municipality noted:

> *"D&B project procurement strategy is not a magical system that works by itself. It is more difficult to plan, scope, manage and implement. I am not sure that the current results justify its selection".*

Other problem areas were related to defining and organizing the work packages into a realistic sequence. The analysis of the findings suggests that the majority of failures are rooted in the accuracy and the quality of the work plans themselves. Losing control of the quality of work is an inherent problem which must be faced at the early stages of planning on a project.

About fifty five percent (55%) of the sample respondents confirmed that they face major problems in properly defining the work packages, identifying boundaries, planning for completion and actually meeting set dates. Inability to properly define the D&B work packages is a major impediment to the adoption of D&B project delivery strategy.

Realistic planning is needed to procure projects along D&B option. If unrealistic time frames are allocated, the design team will make errors which lead to delays and increased costs. D&B firms must develop the procedures to balance technical issues

with time, cost and human factors. Senior management's support, appointment of a dedicated project manager, maintaining a fully engaged design team with site coordinators is imperative for the success of a D&B project.

There are contractual problems that are impediments to the adoption of the D&B. Over sixty percent (60%) of the consulting and contracting firms reported that they face major contractual, scope definition and financial problems when procuring D&B contacts. They reported the following problems:

- Lack of fair financial compensation. Change orders and variations are not always compensated. Many clients refuse to appoint an independent cost engineer.
- Lack of accurate scope of work definition and means of interpreting the performance specifications.
- Failure to reach agreement on contractual and schedule terms. This lead to litigious relationships.

D&B contract documents contain onerous bespoke clauses and penalty clauses. Most of the risk is assigned to the D&B entity. A thorough review of the current contracting environment is required. Fair contracts must be developed. Internationally recognized industry standards should be used as a benchmark. The case study and the direct interviews provided specific data on this project, including the consequences of project planning failures or massive schedule slippages.

Claims and variation orders increase in number as the end date slides. For improvements to succeed, D&B firms must provide the proper professional advice regarding the project procurement option for a client to follow. When a D&B approach is chosen, they must allocate an experienced internal technical and management team to handle the project. They must be truly conversant with contractual requirements. Fair contract clauses with shared risk allocation must be agreed to mutually. This fosters participatory work environment. Fear of making mistakes and an attitude of blame for not meeting delivery dates must be removed. This will increase the popularity of D&B contracting and encourage new entrants to explore the potential benefits of this project procurement strategy.

Table 7.4 summarizes the current impediments related to this category and the proposed recommendations.

Table 7.4 Organizational and Contractual Impediments and the Proposed Recommendations.

IV – Organizational and Contractual Impediments		
Current Impediments		**Proposed Recommended Improvements**
1. Many D&B firms do not have the internal project organizational and project management structure to procure D&B projects.		Project management is the key to monitor the performance control, and timely delivery of the any project and particularly D&B projects. Building a dedicated and integrated project team to procure D&B projects becomes a must for the success of the project.
2. Inadequate scheduling, reactive planning, absence of clear and realistic priorities of work packages are reasons for unpopularity of D&B contracting.		Adequate time must be given to the D&B firms to complete each scheduled activity. Time should not be compromised if there is no true justification for doing so. Independent project technical coordinator must be part of the delivery team to cover coordination areas. Design and quality checks shall be performed concurrently.
3. There is a lack of trained and experienced project managers capable to procure D&B projects. This major impediment to the adoption of D&B project procurement option.		Continuous training and educating the staff on how to procure project on D&B path is key to the success of D&B projects. The PM will forecast the resources required, control expenditure of man-hours and monitor progress of work against project objectives, and measure actual performance and propose remedy plans.
4. There are contractual problems associated with D&B projects. The D&B contracts contain many bespoke clauses. Penalty clauses are unfair and almost all risks are shifted to the D&B entity.		D&B contracts must be fair to all parties to the contract. The parties must agree mutually fair contract clauses with shared risk allocation, clear duties and responsibilities, clear financial compensation terms and fair dispute resolution procedures. A review of the current contracts must be conducted by the government concerned authorities to establish fair grounds and legal rights for D&B contracting formalities.

5. Design changes, modifications, revisions, and changes in scope require additional time and cost. The majority of D&B clients are only interested in the first cost. They do not compensate D&B entities for variations.		In construction, change is never recommended unless for reasons that are justified and considered. Variation orders which are outside the agreed and contracted scope of work must be defined. Any additional work/modification must be measured. Additional time and cost must be mutually defined and compensated.
6. D&B clients must carefully and explicitly define the scope of work and the performance specifications of their D&B projects. D&B contracting firms find this area to be a source of claims. Misunderstanding due to misinterpretations of the performance specifications occurs.		D&B procurement strategy requires knowledge to accurately prepare the bidding documents, the scope of work and the performance specifications. It also requires understanding of construction sequences and priorities of work, planning of activities between the design office and the site. Performance specifications Work packages must be defined planned from the start of the project, preferably with the participation of the contractor. Work plans should be realistic and achievable.

7.2.5 Fear of Inferior and Unsatisfactory Quality of Works.

This category covers impediments related to the perception that D&B projects result in inferior quality. The end result of the project is not as desired. Major problems result from rushing to release design information to the site and the disappearance of clear and defined design phasing. Pertinent literature reveals that proponents and critics of a D&B projects use similar criteria for judging effectiveness and performance of the D&B projects.

The majority of the consulting and contracting firms acknowledged that maintaining an acceptable quality standard of work is a problem. Another problem reported was the inevitability of rework caused by either poor coordination or wrong design decisions. Over sixty percent (60%) of the combined survey results confirmed this.

Public and government authorities' clients expressed the same concern. Over fifty percent (50%) reported a preference to procure their projects using the D.B.B. They believe that it offers them better quality. They specifically pointed to undetected errors and the lack of sufficient design information being released to the site. Fifty eight percent (58%) of those answering confirmed that D&B entities compromise the quality level. Therefore, they seek other options for delivering the contracted work. Some of the respondents stated that some D&B contractors are known to work differently when behind schedule. They push design work to the subcontractors to expedite things.

On the other hand, over forty five percent (45%) of the D&B proponents from the consulting and contracting firms reported that D&B offers the same quality and sometimes better quality. The analysis showed that proponents of D&B option believe that there is a greater focus on quality control and quality assurance. This is due to the continuous involvement by the design team throughout the project. Innovation is another area contractors can bring to D&B projects in Saudi Arabia in the opinion of these proponents. One quantity surveyor from the consulting firm stated:

> *"One would ask, why is the D&B option well practiced everywhere in the Gulf Region, except here in Saudi Arabia. The problem is not in the procurement option but rather in selecting the appropriate project delivery team of consultants and contractors."*

The following impediments were identified by the sample proponents:

- D&B projects are not pleasing. They reflect simple designs with excessive unnecessary repetition.
- The structural design and construction is rushed and constructed. The remaining disciplines are forced and made to work.
- Work packages reach the site uncoordinated. Many errors cannot be rectified and stay forever.
- Late modifications are expected due to wrong earlier technical decisions.
- Not enough coordination of technical decisions between the various design disciplines, and with the construction activities. Quality checks are minimized.
- The boundaries between each design phase disappear and all activities are on the critical path. Time takes precedence over quality. Simplification of the design becomes necessary.
- Time needed for the sequential and phase technical coordination is reduced significantly and there is little time to review detailed design and perform quality control. The analysis of the results showed that consultants were sending documents out for pricing and tender with performance specifications only and, in many cases, changes are made at a moment's notice.

Improvements and solutions were suggested by the proponents of the D&B option. The project must start with a clear scope of work, accurate schedule of areas, correct bills of quantities and definitive performance specifications. The bills of quantities will enable D&B firms to monitor the cost items and their quantities. This differs from the current practice that is limited to preparing unit rates. Unit rates alone hide the true costs. The magnitude of these items is not immediately recognizable.

Another suggestion is to perform on-board design reviews and quality audits. This would optimize the design to meet the project objectives. When warranties are a part of the contract, project quality takes on even more significance due to the added cost exposure. D&B projects require a full time independent coordinator who continually reviews and coordinates the work flow between the design disciplines and the site activities. He/she measures good performance. The PM and the coordinator would

jointly plan the overlapping of various activities based on priorities. The performance measures require the following:

- The initiation and introduction of a creative and flexible problem solving technique.
- Amending the QA and QC procedures to yield better quality audit
- Coordination the design documents
- Check the design documents against the client's brief
- Reporting deficiencies and missing information, or design flaws before release for construction.

The designers on the D&B team are constantly updating the design through all phases of the project. Therefore, areas of errors and mistakes are inevitable. One solution to this problem is to introduce an orderly process for the formal review and approval of changes. This technique keeps track of all the changes after the establishment of the design baseline. It records all changes, their source, and reasons. The report of this data is sent to the PM for him/her to take the appropriate action.

Table 7.5 summarizes the current impediments related to this category and the proposed recommendations.

7.2.6 The Process of Selecting and Awarding the D&B Projects.

The D&B procurement option requires special skills and foresight that mandate the selection of a competent D&B contractor. The choice of contractor and subcontractors is of paramount significance. The Contractors' prequalification selection criteria must include factors such as, competence, reliability, financial health, knowledge and awareness of construction techniques and methods, along with a proven track record.

Sixty four percent (64%) of the consulting firms stated that they would consider a D&B project if they could choose the contractor. Similarly, fifty one percent (51%) of the contracting firms responded that they would consider a D&B project if they could select the designer. Public sector clients and government authorities' clients preferred to work with nominated D&B firms who have a long term relationship with them. More than sixty six percent (66%) majority of these clients were found to be unaware of an industry project procurement system. Consequently, these clients do not use such a model to choose the best procurement system for their projects.

Table 7.5. Fear of Inferior and Unsatisfactory Quality Impediments and the Proposed Recommendations.

V – Fear of Inferior and Unsatisfactory Quality of Work.		
Current Impediments		**Proposed Recommended Improvements**
1. D&B projects are considered boring, monotonous and have many unnecessary repetitions. This undesirable image deters many clients from considering D&B project procurement option. D&B is delivery is merely a way to get around current regulations that protect the interests of and promote continuous competition among competent project design and construction firms in Saudi.		Successful D&B projects must be published and analyzed. This wrong image needs to be challenged. Conducting case studies and publishing completed D&B projects will improve the perception of D&B option. D&B promotes innovation and good design especially if the designers are partnering with the contracting firms. Starting the D&B process with a design competition stage would encourage D&B firms to innovate.
2. Problems result from designing the structural frame first and fitting the other disciplines into it. This leads to waste and errors.		D&B sequence of construction mandates that foundations are built before of the completion of the entire structural frame design. This does not indicate that the architectural and MEP design is expected to lag behind.
3. The D&B project design brief and performance specification documents are not always clear. This leads to the misinterpretation of the project requirements and quality standards.		D&B project procurement strategy takes more time at the start of the project due to the preparatory work required to compile the scope of the design stages and to establish the performance specifications. Preliminary design time must not be compromised, since this is where fundamental design decisions are made.
4. Poor coordination between work packages occurs due to the limited time allowed for the design to develop.		An independent review team must be appointed to coordinate all trades. This team will track design errors and report them to the PM for remedial action before they go to tender.
5. No systematic plan to manage and handle delays, design changes, and variation orders. Things move too fast and delays cannot be avoided.		Configuration management technique must be employed to keep track of changes, monitor why and when they occur, and advise the PM of the resources needed to overcome potential delays. This

		system should apply to both the design and the site activities. An effective communication management system must also be established to keep record of all pertinent correspondences, reports, drawings and relevant information.
6. The D&B strategy and process does not allow the proper sequence of QA/QC reviews at various design phases. Many drawings reach the site unchecked and errors are inevitable. Some mistakes are irreversible.		Although a level of assumptions is made, nevertheless, design and construction work can proceed with a degree of certainty if work packages are accurately defined. QA/QC reviews of the work package can occur as they are being developed.
7. Technical decisions are made ahead of time, in the dark, and without full knowledge of the entire project's objectives. Thus, wrong assumptions are discovered later.		The PM must continually measure the compliance of work against the established project targets and baseline. Where deviations occur, the PM must have an information tracking system to identify the reasons for the deviations and take the necessary measures to reduce or eliminate any deviations.
8. Lack of regular, controlled feedback from site that can be incorporated and coordinated into the next work packages.		A feedback system must be set in place through the site coordinator so that all changes, errors, and design modifications are recorded and fed back to the PM and the coordination team at the design office. Their resolution and incorporation can occur in the next work package.

Only minority of a thirty three percent (33%) of the public sector and government authorities clients were aware of an industry best practice prequalification process. It is a process based on evaluating technical and commercial proposal standards.

These clients tend to award D&B projects using competitive bidding that is based on lowest price. These results are consistent with those reported by (Jaweed, 2004) and (Janadi, 1997). They reported that a large number of the Saudi construction industry clients are unaware of the D&B procurement process. In particular, they are unaware of the preparation and award process for a D&B project. One public sector client stated:

> *"The problem is not really related to the D&B project procurement system, but rather with the type and capabilities of the D&B contractor. A good contractor can be the reason for the success or failure of the project"*

The importance of contractor's evaluation and selection for delivery of projects was reported in the literature review. Watt *et al.* (2010) conducted an empirical study to investigate the contractor evaluation and selection process for the delivery of projects. They reported that technical experience and track record were the two most significant criteria that were used in an actual choice of contractor.

Areas of improvement lie in defining the projects that are best procured following D&B option. Similarly, a process needs to be set for selecting competent D&B firms. More work is needed at the front end of the project to pre-qualify D&B contractors using the best practice two-stage process.

D&B firms must have capabilities in project management, design, procurement, planning and construction. Technical complexity and an accelerated completion schedule can be better managed when a D&B contractor is on-board early. They can offer recommendations during the design. Given this, many reoccurring problems, reported by the respondents, can be resolved. These include:

- Planning the work load, defining the work packages, and setting the priorities can all be discussed and agreed upon with the D&B contractor. This will reduce the level of essential detailing required and thereby save time. Both parties will focus only on the essentials.
- Agreement of the work packages that will be issued to the site, their timing, and the extent of detail level. Certain design packages may be influenced and

enhanced with the buildability knowledge and experience that the contractor will provide.

- On board value engineering will be conducted to meet the performance specifications
- Innovate to provide the highest quality of construction at the lowest price.

The current predominant contract terms and relationships must be modified for D&B to succeed. Shifting delay and risk problems onto the D&B contractor by imposing unfair contract clauses develops adversarial relationships. This forces the D&B contractors to raise their risk premiums and increase their tender price. **Table 7.6** summarizes these impediments and the proposed recommendations.

7.2.7 The lack of Available Medium and Small Size D&B Contracting Firms.

This category received much attention. The answers confirmed that the local construction industry critically lacks the active medium and small size D&B contracting firms. This major impediment was reported by over sixty percent (60%) of the sample. Many potential D&B projects are cancelled due to the unavailability of medium size D&B firms.

Medium size firms avoid entering this market due to a lack of required knowledge to integrate design and construction activities. They are concerned with the loss of control and the impact on quality, cost bonding and insurance.

This problem is creating contractual and political concerns. Many public sector clients believe that the limited number of D&B contracting firms is creating a monopoly in the local construction market. These D&B firms have the advantage of manipulating their prices and contractual terms. Medium to small size firms can not afford the initial costs involved in preparing a D&B proposal, involving the preparation of an initial design and substantial bidding costs. Without medium and small D&B firms, the large D&B firms put forth higher prices that clients must accept. This situation does not help to increase the popularity of the D&B project procurement option. Ruknelddine (1999) reported that only limited numbers of local contractors are interested in procuring D&B projects. Most of them fear of losses associated with this procurement path. Jannadi (1997) found out that only twenty four percent (24%) of the local consulting firms were interested in partnering with a contractor to procure D&B projects.

Table 7.6. The Impediments Related to The Process of Selecting and Awarding the D&B Projects and the Proposed Recommendations.

VI – The Process of Selecting and Awarding the D&B Projects.		
Current Impediments		**Proposed Recommended Improvements**
1. There are not many experienced contractors available and those available are either busy or charge high rates. It is difficult sometimes to differentiate between the experienced ones from those who are not.		This problem exists because of the high demand for construction during boom times only and not at lean times. Setting realistic deadlines by clients and offering equitable share of risks and benefits will help resolve this problem. It will encourage contractors to consider D&B projects.
2. Many clients are not aware of the availability of an industry project procurement selection system.		Through education, research and organizing joint conferences attended by public and private sector clients, contracting and consulting firms, these project selection models will become known to all stakeholders.
3. The local construction market is dominated by the low price culture. Two stage prequalification process requires a change in the government contracting documents.		The selection criteria should not be based solely on lower cost only. Rather, the selection should be on experience, reputation, knowledge, track record and quality of work performed. By using technical and commercial prequalification process, this problem can be resolved.
4. It was common practice that many contractors entered into D&B agreement to win the job. Once successful they make substantial profit from claims and overhead.		This problem can be solved by establishing a pre-qualifying procedure for choosing the contractors. Partnering with the supply chain is a concept that can also be applied for choosing the contractors and suppliers who prove to be reliable, and meet the quality standards.
5. How is it possible to manage the D&B contractors who are continually frustrated and demand detailed construction drawings instantly.		This problem can be resolved by planning and scheduling the delivery of design drawings, specifications and other contract documents from the outset. Once contractors know what is coming and when, they can plan and sequence their work.

These consultants according to Jannadi expect pitfalls associated with D&B option. **Table 7.7** Summarizes the impediments related to lack of available medium and small size D&B firms and the proposed recommendations.

7.2.8 The Risk of No Cost Certainty, Delays, Litigious and Adversarial Relationships.

This category covers perceived risks, schedule overruns, and disputes associated with the D&B project procurement option. After schedule and complexity, cost control is the next most frequently cited reason for using D&B. Particularly, the public sector and government authorities wish to minimize the extent and impact of change orders. However, the majority of the sample reported problems associated with D&B project procurement option which include:

- D&B option offers no cost certainty.
- There are Expected delays with D&B option.
- Most D&B projects do not have a happy ending. Disputes and legal cases are inevitable

Consulting and contracting firms acknowledged with a sixty five percent (65%) combined majority that D&B option requires additional management and resources costs. There is the additional cost of rework and repairs which are inherent with D&B procurement. There are also cost of delays due to wrong design decisions and uneconomical design assumptions.

The public sector clients confirmed with fifty five (55%) majority that D&B requires substantial "up front" investment in the project. This includes additional project management, employing skilled professionals, and setting new work procedures with effective planning and control tools to coordinate design and site activities. The insurance firms and government authorities' results reveal that many clients and D&B firms end in courts to resolve their legal cases. As one analyst from the insurance firm out it:

> *"Engineers and technical professionals are expected to make financially based decisions, often without a formal financial background or training on best practices in capital investment analysis"*

Table 7.7. Impediments Related to the Lack of Medium and Small Size D&B Firms and the Proposed Recommendations.

VII - The lack of Available Medium and Small Size D&B Contracting Firms.		
Current Impediments		**Proposed Recommended Improvements**
1. Lack of understanding of the principles of D&B project procurement option is causing confusion and many medium and small size firms avoid this procurement option.		More education is needed about the advantages and disadvantages of this project procurement system. This process should be lead by the government and the private sector. Providing actual successful examples will encourage medium size firms to partner to procure D&B projects.
2. Contracting firms believe that clients set unrealistic targets which lead to disputes and confrontational relationships. This discourages the formation of medium size D&B firms.		Realistic and manageable targets must be mutually agreed. Clients must offer additional premiums to the D&B firm to offset the additional risk cost associated with D&B projects. This will encourage certain hesitant D&B firms to consider embarking on this delivery option.
3. Because many D&B clients are not allocating sufficient contingencies for unforeseen risks/uncertainties. They shift all types of risk to the D&B firm. This is a major impediment to D&B contracting.		Some projects are fast tracked for other motives and not always economical. Clients must be made aware of the cost of D&B projects and risks associated. Risk sharing will encourage more contracting firms to consider D&B option. Higher ratio of contingencies must be allowed under this project delivery option.
4. Clients are not accountable for the schedule slippage and delays attributed to them for not making timely decisions. This practice is increasing the unpopularity of D&B option.		Clients must be made aware or contractually “forced” to make timely decisions when expecting the D&B firm to perform and deliver more and faster. A more cooperative relationship between clients and the D&B entity must develop; based on trust, and coincidence of interests. Clients will only learn by seeing real examples of successfully published D&B projects.

The literature review included in Chapters Two and Three shows higher quality costs additional premiums to maintain design quality with the D&B option. More and concurrent review time and coordination time is needed and the cost will rise even more.

With D&B procurement, the level of risk increases. This mandates that full time qualified and experienced QS and planners manage cost and variations and the schedule. Since construction costs associated with delays are high, D&B firms over estimate the space requirements, order additional material and take measures to minimize, or limit, any delays. The QS has reduced time to check quantities since the drawings are being constantly updated, often without the knowledge of cost engineer. Consequently, the take offs are expected to be wrong.

These problems impact the overall planned costs and push the target budget to higher levels. Cost also increases if the quality and coordination reviews are not performed on regular basis. Mistaken information reaches the site. Once detected, usually too late, major repairs and rework are required.

Improvements are needed to minimizing wasted space and to control deviations in specifications. Using practical measures, D&B firms can reduce the project costs. The documented design details and choice of materials have a major impact on the speed of construction and overhead cost. Simple detailing for ease and speed of construction achieves the cost target and completes the project on time. This limits the range of imported materials saves substantial time and cost.

Experienced D&B firms minimize the project costs by restricting the complexity and interdependencies of materials and construction details of different trades. Standardizing the detailing and building techniques will speed the construction process. The teamwork facilitated by D&B offers a structured, fast and effective way to discuss, analyze, and explain highly interdependent tasks. This diminishes rework. Misconceptions and misunderstandings caused by fragmenting the team are reduced.

Achieving an optimum and uncomplicated, but aesthetically acceptable design is the main focus. It needs to be built efficiently within the schedule and financial constraints of the client. **Table 7.8** summarizes these issues and the proposed recommendations.

Table 7.8. The Impediments Related to the Risk of No Cost Certainty, Delays, Litigious and Adversarial Relationships and the Proposed Recommendations.

VIII- The Risk of No Cost Certainty, Delays, Litigious and Adversarial Relationships.		
Current Impediments		**Proposed Recommended Improvements**
1. Many D&B clients introduce design modifications and changes during the construction stage and refuse to provide additional costs and time. This leads to adversarial relationships.		Clients must modify and/or change the contractual clauses to accommodate new terms within the original contract. Additional costs must be agreed and the delays, penalties and liquidated damages, clauses must be altered. Delay clauses must be matched with incentives for earlier completion.
2. Cost of rework increases due to wrong or inaccurate design assumptions. Because of the speed and time pressure, D&B firms make hasty decisions which can be wrong and irreversible.		An independent QA/QC and coordinator team must be employed to audit the design and contract documents before they go out to site. Errors must be detected at source. This team must continually question, redefine and update the design assumptions to minimize the impact of having un-optimized building.
3. Overestimating structural sizes, electro-mechanical space requirements leads to higher unnecessary costs.		With D&B procurement option, certain design decisions must be made based on educated estimates and past experience. This is part of the D&B process.
4. More materials are ordered at the beginning of the project to off-set the cost of delays. Waste of unused material is imminent. This translates into claims and change orders.		The extra material problem can be resolved by partnering the supply chain. Additional materials can be returned and/or changed when dealing with suppliers on long term basis. In addition, the QS's role must be signified since he/she monitors the cost plan.
5. D&B clients find out about how expensive the D&B option too late. There is no cost certainty.		Many D&B contracts are signed based on GMP or priced bills of quantities. Achieving cost certainty requires the PM to regularly review the project costs against the cost plan, defines deviations and act to limit their impact on the project's cost. The client must always be made aware of the current and projected project cost.

7.2.9 The Government's Contracts are Based on the Procurement of the D.B.B Project Delivery Option.

This category covers the impediments related to the current D&B contracts which are predicated on the traditional sequential D.B.B project delivery option.

Seventy eight percent (78%) of the public sector and government authorities' clients respondents reported that this is a major obstacle in advancing and increasing the popularity of the D&B project procurement option. The Saudi industry design and construction contracts were developed more than half a century ago. They are in fact based on low cost tendering for reasons of accountability and careful spending of government funds. The analysis of the results revealed that the D&B contracting option is now utilized for special, rushed and complex public sector projects using inadequate contracts. Other private sector D&B projects are being procured utilizing international contracts and through the appointment of international consulting firms. Even when large public sector projects are procured utilizing D/B option they require the approval of the highest office at the ministry. According to one of the insurance company respondents:

> *"The legal supporting system in Saudi is also based on dealing with cases of D.B.B project delivery option. With the D.B.B the responsibilities of the parties are clear and the judicial system is well familiar with it. However, D&B is a new procurement system and the local legal system has not experienced enough with it to master it."*

Improvements are needed to modify the current contracting documents to properly include procuring projects along the D&B option. The use of a two stage prequalification process for selecting and awarding D&B projects is highly recommended. This will ensure that the contractor's selection process is based on technical and commercial capabilities and not just the cost.

The government is also expected to reduce the time it takes to process building permits and partial approvals. This will facilitate the implementation of D&B option. **Table 7.9** summarizes the impediments related to the government contracts and the proposed recommendations.

Table 7.9. Impediments related to Governments Contracts that are Based on the Procurement of the D.B.B Project Delivery Option and the Proposed Recommendations.

IX –The Government's Contracts are Based on the Procurement of the D.B.B Project delivery Option.		
Current Impediments		**Proposed Recommended Improvements**
1. The current public sector contract documents		The government is invited to properly define the principles and procedures of this technique, regulate its application and implementation, and set an example by procuring projects along this path. More examples need to be published before the private sector can fully accept the advantages and disadvantages of this option.
2. Local authorities are not issuing partial building approvals. This is delaying the early construction and issuance of permits on time.		This problem can be resolved once the government fulfills the needs of regulating and controlling the procedures to enable D&B implementation. The government is invited to facilitate the issuance of permits in a timely manner whilst setting conditions and rules for how to approach this procurement path.
3. Insurance companies are demanding high premiums for liabilities, risks, and errors for projects running along fast track. This is preventing many clients and design firms from choosing this delivery technique.		This problem will be resolved once the government establishes a framework that regulates the application and implementation of this technique. Once the level of awareness increases in the industry, clients, investors, consulting firms and suppliers will become more knowledgeable with this technique. Uncertainties, risks, and fear levels will reduce and so will the insurance coverage.
4. Lack of education and experience with this project delivery option are reasons for its slow progress and improvements.		The government and the local engineering professional bodies are invited to spread the knowledge about this technique through seminars, benchmarking, education, and most of all, presentation of real examples showing the advantages of this technique and also showing the problem areas to be avoided.

7.2.10 The Government's Role in Leading the Industry.

7.2.11 The lack of knowledge regarding the true meaning and proper implementation of D&B strategy by a significant majority of the Saudi construction industry stakeholders is frightening. Currently, the local developers, a few government authorities and some private sector clients are knowledgeable in procuring projects using the D/B strategy. Seventy percent (70%) of the respondents representing the seven sectors confirmed that they are not aware of an existing project procurement selection model that would foster more D&B projects. Sixty five percent (65%) of the public sector and government authorities clients do no use the two stages prequalification and award process to award D/B contracts.

The problems identified above must be dealt with at different levels. The professional institutions and the local engineering societies need to increase the public's awareness. The local consulting firms, government authorities, and public sector clients suggested that the government take the lead to commission a professional entity who would define the practical principles of this project procurement strategy. The government is also expected to find the way to expedite the process to grant approvals of building permits. This will benefit D&B projects. The release of partial approvals on design packages will enable the overlap of design and construction activities. These steps will facilitate the implementation of D&B project procurement strategy.

In summary, the role that the government can take to promote the adoption of D&B strategy includes:

- Spread awareness of D&B project procurement strategy
- Change the current contracting rules that are based on D.B.B and provide for D&B option.
- Publish case studies about successful and unsuccessful D&B projects and draw conclusions.
- Sponsor conferences, seminars and symposium focused on the pros and cons of D&B contracting.
- Benchmark the local construction industry performance with other countries to learn lessons and measure productivity.

Table 7.10 summarizes the role that the government is expected to play, the current problem areas and the proposed recommendations.

Table 7.10. The Government's Role in Leading the Industry, The Impediments and the Proposed Recommendations.

X – The Government's Role in Leading the Industry.		
Current Impediments		**Proposed Recommended Improvements**
1. There is an obvious lack of knowledge and understanding regarding the principles and applications of D&B option in construction. The legal system is unfamiliar with D&B procedures and contracting arrangements.		The government is invited to define the principles and procedures of the D&B option that will regulate its application. The government shall set the example by procuring projects along this path. More examples are needed to be published before the private and other sectors can accept the D&B option. The legal system will eventually catch up.
2. Local authorities are not issuing partial building permit approvals. This is delaying the early construction and issuance of permits on time.		This problem can be resolved once the government fulfills the needs of regulating and controlling the contracting procedures. The government is invited to facilitate the issuance of permits on a timely manner whilst setting conditions and rules for how to approach this procurement path.
3. Public sector contracts are based on D.B.B contracting. This limits the use of D&B contracting.		The government is invited to amend the current contracts that are based on the D.B.B and include for the adoption of D&B option. This will be accompanied by sufficient procedures to define when and how to apply D&B contracts and to what projects. Standardized contract language for D&B procurement, including general and project specific requirements will encourage the adoption of this option. The authorities should continue to develop guidelines and illustrative documents for use by clients interested in evaluating the D&B delivery method.

7.3 The Proposed Guiding Framework for the Clients who are Interested in Procuring D&B projects. Steps to Consider.

The above ten impediments represent the problem areas that hinder the adoption of D&B project procurement option. They are the reasons for the slow acceptance of the D&B procurement option by the Saudi construction industry. The survey analysis results suggest that the majority of the public sector clients, the government authorities' clients, and a significant group of the private sector clients all lack the knowledge and understanding of the D&B procurement system. The results also revealed that the majority of these clients do not utilize a standard industry project procurement selection model to select the optimum path to procure their projects. In order to assist these local construction industry clients, the author has developed a step- by- step systemized procedure to approach and apply the D&B project procurement strategy. This procedure guides clients through the stages involved in implementing the D&B option. The framework is illustrated in **figure 7.1** It is comprised of six main phases of decision making and the steps to be followed.

Phase I. Definition and Justification for Selecting D&B Procurement Option.

This phase is concerned with the decision whether or not to embark on D&B project delivery option. This is the most critical stage of the project life cycle (PLC). Sufficient care must be exerted to assess the viability of this option. The clients must consider the reasons for choosing this project delivery option, especially the objectives and priorities they seek to accomplish.

Phase II. Prepare the D&B Scope of Work

The client must carefully and accurately define the scope of work for the D&B project. A specialist consultant may be appointed to develop the criteria requirement.

1 The space program for the project.

2 The performance specifications.

3 The contract documents.

4 The design brief for the project and site information. (The client may develop the concept design or invite the D&B contractors to assist in preparing the concept design for the facility)

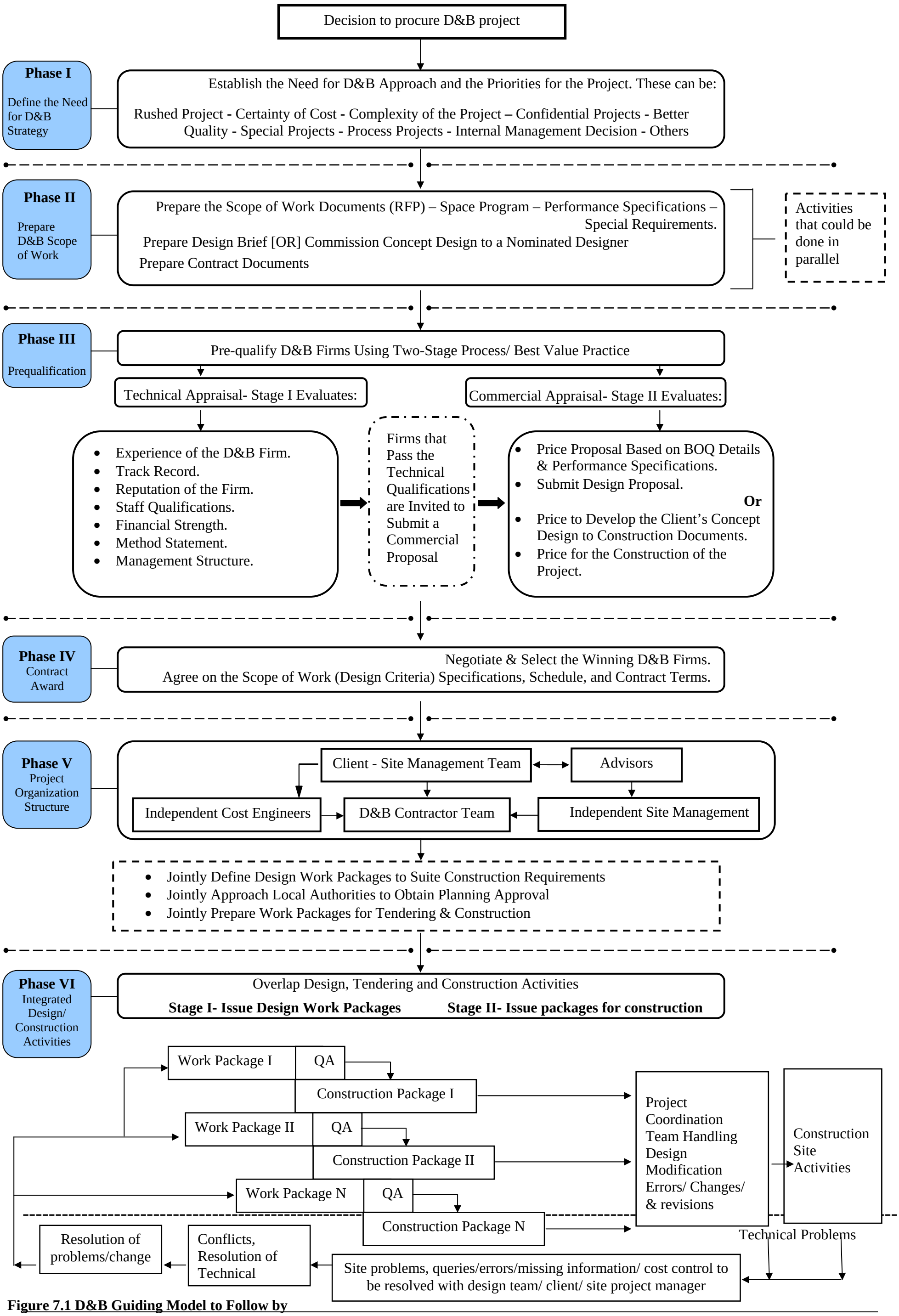


Figure 7.1 D&B Guiding Model to Follow by D&B Clients

5 Instructions to the bidders.

6 Schedule.

7 Other implied requirements.

This scope of work document will establish the requirements of the project and will be used by the D&B contractors as the basis for submitting their proposals.

Phase III. The Prequalification Phase.

Potential D&B firms are pre qualified using the best value, two stage processes. A technical appraisal must be followed by a commercial prequalification. The client prequalifies potential D&B firms based on the following:

- Experience of the D&B Firm.
- Track Record.
- Reputation of the Firm.
- Staff Qualifications.
- Financial Strength.
- Design and engineering capabilities
- Method Statement.
- Management Structure.

A weighted evaluation follows to score points for the firms that meet the technical criteria. Those D&B contractors that pass the technical appraisal are invited to submit a commercial offer to either develop the design prepared by the client or develop the design from the criteria document issued by the client. For the commercial proposal, the clients must evaluate the following:

- Priced proposal based on BOQ details, & Performance Specifications
- Submitted Design Proposal
- Price to Develop the Client's Concept Design to Construction Documents
- Price to Develop the Concept Design for the Construction of the Project

Phase IV. The Contract Award

The contract award is based on a negotiated offer with the D&B entity. All commercial, specifications targets, schedule, contractual and insurance terms are discussed and mutually agreed upon. All risk matters and payment terms must be resolved at this phase. This is in advance of all contractual matters being resolved. Tender queries and all negotiated terms shall form part of the contract documents.

Phase V. Project Organization Structure

This phase looks inside the client's firm and describes the basic restructuring and organizing of the project team in a flow chart. Definition of the tasks that will be taken to advance the design activities, identification of the work packages, and establishment of a responsibility matrix of the team members will greatly contribute to the success of the D&B process. The D&B contracting demands specific requirements from the client such as:

- Design Review Team.
- Technical and Legal Advisors.
- Independent Cost Consultant.

This phase is essential for the proper running of the project. The client shall have a qualified technical and estimating team review design drawings, approve samples and respond to D&B queries. An independent cost engineer should review monthly progress payments. The client should provide a professional to review the variations and modifications. This is one major aspect that would comfort D&B contractor and create an unbiased work environment.

Phase VI. Integrated Design and Construction Activities

This phase illustrates the method for integrating and overlapping design and construction activities. Significant time is needed to efficiently and concurrently coordinate the flow of information between the design team and the site. Regular feed back and continuous assessment of the project progress are essential. Design work packages are jointly identified. Priorities are set in order to allow for the construction activities to commence. This phase illustrates the process of issuing early design packages, conducting on board quality assurance reviews, and issuing the work packages to the site for construction. Inevitable problems and conflicts that are bound to surface throughout the D&B PLC are handled by a defined process. The mechanism to deal with these matters is described. **Figure 7.1** is a generic Model which can be referred to at various stages of the PLC. It assumes that consultants and contractors are knowledgeable with the requirements of each activity described in this Model. This chart is intended to guide clients who are willing and interested in procuring their projects under the D&B option. It graphically depicts movement from one phase of the PLC to the next, the main tasks that are expected to be performed, and the method to achieve them.

7.4 Summary

This chapter focused on the main findings of the analysis. The major impediments to the adoption of D&B procurement option were discussed and highlighted together with proposed recommendations and to overcome these impediments. Ten impediments where identified which impede the successful application and implementation of D&B project procurement strategy.

The Saudi construction industry, as a whole, is undecided about whether or not to embark on this D&B project delivery option. Consultants are divided between those who would take the risk and those who only accept D&B projects if the correct fees are offered and current contract terms are modified. The main problems relate to a lack of knowledge regarding D&B contracting, cultural barriers and mistrust between clients and contracting firms, the absence of internal organizational restructuring of many D&B firms, poor definition and planning of work, and the overlap between design office and the site. The case study that was submitted revealed the problem of managing an increased number of sub-consultants and sub-contractors. The impact was far more reaching effect than expected. Contracting firms are willing to embark on D&B projects provided they select the design firm and reach a fair contractual agreement with the client. The current government contracts which are used to procure public sector D&B projects are based on the D.B.B traditional option. These contracts were found to impede the popularity of D&B option. The recommendations suggested to make the D&B approach more attractive are as follows:

1. The need to spread knowledge and increase awareness and a common understanding regarding the components of the D&B project delivery system by referencing other D&B projects abroad.
2. The dominating cultural issues of rivalry and mistrust between clients and contractors are identified. A more collaborative win-win working relationship is crucial. Encouraging dialogue between consultants and contractors needs to start at institutional levels. Partnering concepts on long term relationships present a valid option.
3. Careful assessment is needed to choose projects appropriate for D&B.
4. Accurate and precise RFP and a criteria document are needed for procuring D&B projects.

5. Leaving the design guidelines "loose" with performance criteria so that innovation and creativity of the D&B team will increase.
6. To the extent practical, clients should provide flexibility in the design criteria by using performance criteria to encourage creativity by the D&B team
7. Forming associations on a long term basis between the consulting and contracting firms is a key factor promoting D&B contracting.
8. Inviting the supply chain to be an active participant in the delivery process is one way of solving the division and fragmentation within the construction industry.
9. The appointment of a dedicated project manager and building a competent design team where the contractor is welcomed to participate in certain discussions related to the constructability and construction knowledge.
10. Encouraging the formation of small and medium size D&B contracting firms will increase the popularity of D&B contracting.
11. The government is invited to take the lead in initiating the change from the dominance of the traditional D.B.B current practice, amend current contracts which are based on D.B.B and move more towards adopting new project delivery options. The government shall develop suggested guidelines and illustrative documents for use by clients interested in evaluating the D&B project delivery method.
12. The importance of selecting a qualified D&B contractor using a two-stage best value process rather than low bid basis.
13. Raising the expertise and experience among the clients' managers is a key challenge. Clients should invest in D&B training before attempting to execute their first D&B project. That training should include not only the client personnel but also consulting engineers and construction contractors that will compete for these projects.
14. Training will offer the local industry clients the opportunity to gain greater experience with this project delivery method and the use of performance based specifications.
15. Local authorities are asked to find more efficient ways to accelerate the approval process and to issue phased building permits.

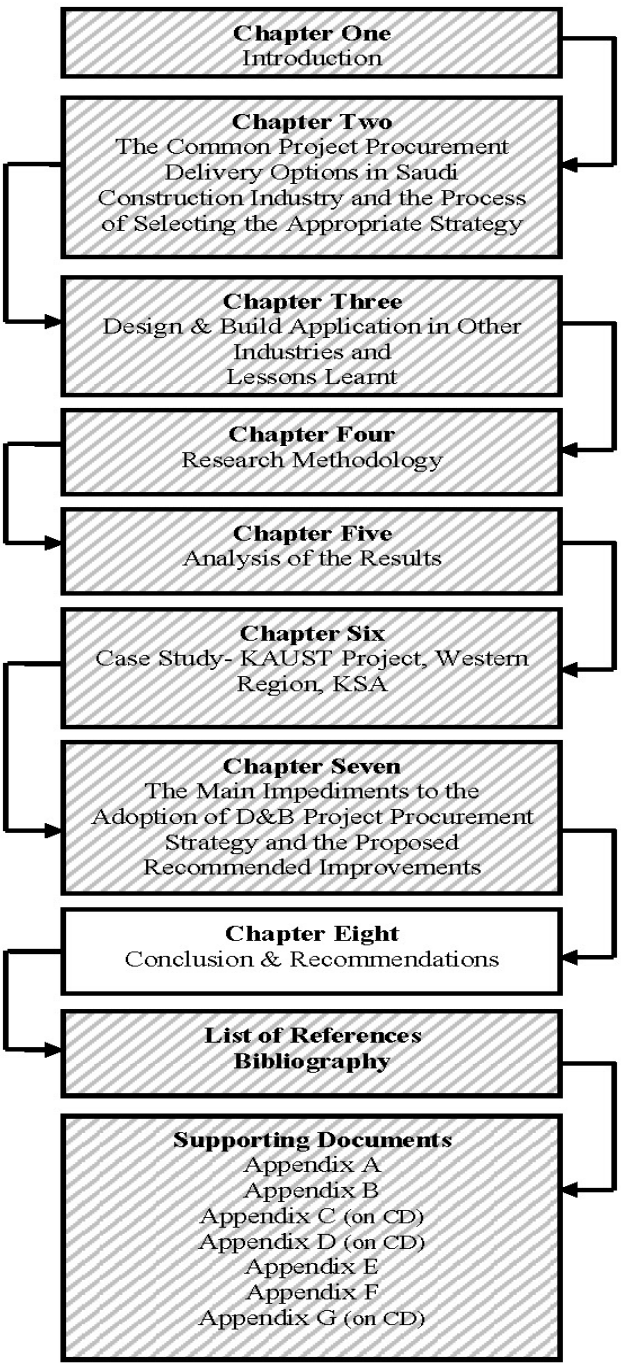
16. Local insurance firms are invited to work closer with the D&B firms to define the inherent risks and uncertainties and to find the means to mitigate and reduce the associated high costs of D&B insurance policies.

Finally, the importance of selecting a qualified contractor was an area of significant importance. It was proposed that the selection criteria must not be based only on lowest tender cost. Instead, reputation, and track record are more important attributes that should be considered while selecting a contractor. This criterion was highlighted in the literature review by (Chen *et al.* 2010) who argued that selecting the appropriate qualified and experienced contractor can improve the project performance effectively. The experience of the D&B contractor was important to the respondents. The right D&B contractors can directly participate in areas of reducing time and cost while maintaining quality. This will create a participative work environment with coincidence of interest and mutual benefits.

> *"The more awareness and knowledge that is provided to the Saudi construction industry regarding the D&B project procurement option, the more attractive it will become. If cultural barriers are removed and the government contracts are amended to suite D&B option, a clear encouraging signal will be given to all clients that D&B is a worthy, credible, highly respected means for building and contracting in Saudi Arabia"*.

The next concluding chapter discusses the broader results of this research, the achievement of its basic objectives and the contribution and results of this investigation. Areas will be identified where limitations to the research were encountered. The conclusion will present recommendations for the future.

Chapter VIII
Conclusions and Recommendations.



8.1 Introduction

This Chapter concludes this thesis. It explains the method used to investigate the research questions and the interpretation of the results. It provides a summary of the key findings of this study. The recommendations for improvements are covered and the means for successfully implementing these recommendations are reviewed. Potential avenues that require further investigation are pointed out. Finally, the limitations and difficulties encountered during the fieldwork of this research are presented.

8.2 A Reflection on the Research Objectives

Recent literature indicated that the Gulf region is experiencing an unprecedented boom of daring signature architecture. This is now particularly true in Saudi Arabia. It is home to the world's tallest buildings, biggest malls, largest arch bridges and biggest airports. Projects in this region have pushed the boundaries of design and engineering. Given the current market conditions, the Saudi construction industry is under increased pressure to balance the demand of delivering world class architecture with cost effective solutions. Whilst the benefits of D&B contracting have been directly realized by many different industries around the world, the Saudi construction industry has been slow to accept the D&B option. The traditional design, bid, build project delivery option still dominates the Saudi construction industry. This research offered an opportunity to study the performance of the Saudi construction industry since the early 1980's. The procurement approaches that the industry has employed were investigated which are:

1. Traditional D.B.B project procurement strategy.
2. Design and Build project procurement strategy.
3. Construction Management project procurement strategy.

This study traced the history of D&B in various industries. This procurement option is successfully applied in the manufacturing, digital, and automotive industries. D&B contracting is widely used in North America, Asia and Europe. Its application in construction has increased since the 1980's following its success in the manufacturing industry. The D&B project procurement strategy was introduced into Saudi Arabia construction industry, in the early 1980's. Its timing overlapped three construction booms. The public sector led the first boom. For the second boom in the late 1990's

and the current boom, the private sector played a bigger role. The common contract form used for all these construction projects was the FIDIC with modified clauses that shifted substantial risk to the contractor.

The study examined the local perception of the D&B procurement option, its application and implementation. Recent research by local researchers and writers such as; (Al Kharachi and Skitmore 2009, Jaweed 2004) support the adoption of D&B option for reasons of speed and innovation. This is in contrast to the earlier opposing views reported by (Al Mansouri 1988, Al Jarallah 1983, Al Sultan 1987) who found out that D&B contracting appeared to be a remedy to poor project planning. It was found to be more costly for reasons such as overestimated space and material requirements. Ten impediments that prevent the adoption of D&B contracting within the Saudi construction industry were identified and practical solutions are proposed to overcome them.

To find the answers to the six questions presented in this study, a Mixed Method research strategy was selected. Quantitative and qualitative data from surveys and direct interviews were collected by conducting direct interviews. Direct interviews were conducted with key participants representing consulting and contracting firms, manufacturers, developers, public and private sector clients, financial market evaluators, and insurance firms. To enrich the investigation, a pertinent case study for a university campus procured using D&B option was also examined. The main findings are reported with solutions. The answers to this research study are:

8.3 The Answers to the Research Questions, Aims and Objectives.

The first question aimed at finding the reasons for the dominance of the traditional D.B.B project procurement option in the local construction industry.

First Question

"Why is the traditional project procurement option is still dominant in the local construction industry?"

Consulting and contracting firms were found to be familiar with the D.B.B option. The contractual arrangements are clear. Today, the contract terms and method of payment are clearer in the D.B.B compared to any other project procurement option. Liabilities and responsibilities for the client, consultant and contractor are understood.

D.B.B is institutionalized and has been in practice for decades. It has an established local legal and contractual legacy with clear procedures and application. Many public and private clients, as well as, the insurance sector are in favor of the D.B.B option for reasons of risk allocation and accountability. The public sector clients stated that subjectivity was one main reason for their choice of the traditional D.B.B option. The change to a D&B project delivery option would require a special knowledge, increased awareness, and a common understanding regarding the components of this project delivery system. This would be accomplished by referencing other D&B projects abroad and publishing successful D&B projects.

Second Question

The second question focusing on the nature and types of the impediments to the adoption of the D&B option was a major topic that stands at the core of this study.

> *"What are the impediments to the adoption of D&B? Are they cultural, political, contractual, lack of knowledge, insurance and liability related system, or regulatory?"*

Ten impediments were identified as stated in Chapter Seven with proposals for improvements. These impediments are:

1. There is a lack of knowledge and understanding of the D&B principles and procedures.
2. Cultural impediments.
3. Slow regulatory procedures and the absence of phased permits.
4. Organizational and contractual impediments.
5. Fear of inferior and unsatisfactory quality of works.
6. The current inappropriate process of selecting and awarding the D&B projects.
7. Lack of available medium and small size D&B contracting firms.
8. The perceived risk of no cost certainty, delays, litigious attitude that often leads to adversarial relationships.
9. Government contract documents are based on the procuring D.B.B option.
10. The missing role of the Government in taking the lead for exploring the benefits of the D&B project procurement strategy.

The solutions to these impediments are areas of improvements are:

1. The dominating cultural issues of rivalry and mistrust between clients and contractors require a more collaborative win-win working relationship. Citing the work of (Wong *et al.* 2008), Maurer (2010), advocated that trust can help strengthen and improve the relationship between project partners which, in turn, entails a variety of benefits and creates values and added knowledge for the project as a whole.
2. Encouraging dialogue between consultants and contractors needs to start at institutional levels. Establishing partnering relationships on long term basis presents a valid option.
3. Careful assessment and selection process is needed to choose projects appropriate for D&B contracting.
4. Accurate and precise RFP requirements and a criteria document are needed for procuring D&B projects.
5. To the extent that is practical, clients should provide flexibility in the design criteria. Performance criteria should be used to encourage creativity.
6. Inviting the supply chain to be an active participant in the delivery process is one way of solving the division and fragmentation within the construction industry.
7. The appointment of a dedicated project manager and building a competent D&B team, and the participation of the contractor in constructability, value engineering, and construction discussions are needed.
8. Encouraging the formation of small and medium size D&B contracting firms will increase the popularity of D&B contracting.
9. The government is invited to initiate the change from the dominance of the traditional D.B.B current practice, amend current contracts which are based on D.B.B, and move towards adopting new project delivery options.
10. The government shall develop suggested guidelines and illustrative documents for use by clients interested in evaluating the D&B project delivery method.
11. The importance of selecting a qualified D&B contractor using a two-stage best value process rather than low bid basis.
12. Training in managing D&B projects will offer the local industry professionals the opportunity to gain greater experience with this project delivery method.
13. Local authorities are asked to find more efficient ways to accelerate the approval process and to issue phased building permits.

14. Local insurance firms are invited to work closer with the D&B firms to define the inherent risks and uncertainties associated with D&B projects. In doing so, they need to find the means to reduce the high costs of D&B insurance policies.

Third Question

The question is concerned with the level of the knowledge and awareness regarding the D&B project procurement option that is present in the local consulting and contracting firms. This is compared with selected public and private sector clients, and other key local industry stakeholders.

> *"What is the common level of knowledge regarding D&B contracting amongst the consulting and contracting firms in particular and various industry stakeholders such as the public, and private sector clients, government authorities, manufacturers, and insurance firms? Is there a difference in understanding and implementing the D&B contracting amongst these stakeholders? "*

There is a consistency of the general level of knowledge of the D&B project procurement option. Compared to contracting firms, consulting firms appear to be more aware of this project procurement option. Survey results indicated that consulting firms are seeing a higher level, scale and number of D&B projects on yearly basis. Developers and private sector firms also appear to be more aware of this option compared to government authorities' clients. The majority of the sample respondent is not aware of the existence of an industry project procurement selection model. More that half of the public sector and government authorities clients do not use a two-stage prequalification and award process to select and award D&B projects. These clients have different perceptions regarding the procedures to follow when procuring D&B projects. The problems that they experience include the inability to accurately prepare the D&B bidding documents, manage the D&B activities, and establish a method of payment to the D&B entity.

Suggested improvement include sponsoring a joint effort led by the local order of engineering committee, local universities and professional institutes to increase the level of awareness regarding this project delivery option. More publication, conferences, and focused research are recommended to raise the level of understanding of the local industry stakeholders.

Fourth Question

The Forth question is concerned with finding out the readiness of the local construction industry to adopt the D&B option if certain contractual and regulatory changes are made to the current conditions and regulations.

> *"Would the local construction industry be prepared to consider adopting another delivery option such as D&B if certain changes to the contracting contracts and regulations were introduced?"*

The findings revealed that public sector and government authorities clients avoid using D&B project procurement option mainly because their current government contracts are tailored to the traditional D.B.B option. In addition, the design and construction approval process and the permit issuance process are also developed around the traditional D.B.B option. Consequently, D&B projects face delays in securing approvals and permits. Moreover, the insurance firms charge relatively higher premiums for D&B projects. This deters many clients away from D&B option. The suggested improvements focus on developing guidelines that would be established by the local authorities. The guidelines need to properly define the requirements for submitting D&B documents to obtain approvals. These guidelines must address the following requirements:

- The submission list and the details of design documents required for approval by the local authorities.
- The level of design information contained in these documents.
- The regulations and procedures required to be followed by the D&B firms for each stage of the design.
- The commitment of the D&B entity of the full compliance with the established regulations and procedures.
- The local authorities must devise means to facilitate phased approvals.

In addition, the government is invited to amend the current design and construction contract documents to allow for the inclusion of the D&B option.

Fifth Question

The Fifth question is directed at many local stakeholders. It questions the sensitivity of the local working environment in accepting the role of contractor to lead the D&B team. This question has a cultural and political dimension.

> *"Can the local working environment accept having a contractor leading the design and construction efforts?"*

This category was heavily debated by the consulting and contracting firms. The literature review showed that in Saudi Arabia until recently in 2000, many local clients and consulting firms preferred to keep the division between the consulting and contracting firms. Several past Saudi scholars reported that Saudi clients believe that the involvement of the contractor with the client-appointed designer during the design stages negatively impacts the quality of the design. The literature review revealed that many public and private sector clients prefer to novate the design consultant to the D&B contractor to monitor and protect the interest of the client. There exists a major division in the local construction industry amongst the various stakeholders. Consultants reported that they would consider taking D&B projects if they would choose the contractor and agree on the budget and schedule of the project. They also disagree with providing decennial insurance coverage. The results suggest that consultants fear that contractor led D&B projects, will suffer with poor quality. Contractors stated that they would consider D&B projects only if they know the client well. They insisted that they select the designer for the D&B project. Surprisingly, developers, private sector clients, and manufacturers welcomed the concept of the contractor lead D&B efforts. They felt that D&B contractor led projects move faster, finish on schedule, and meet the budget. A contractor led project offers certainty of delivery and cost.

However, public sector and government authorities sector clients expressed concerns that contractor led D&B projects are subject to claims, cost and schedule overruns, and stand the chance of producing inferior quality.

The negative perception regarding contractor led D&B contracts needs to be challenged. Partnering between contracting and consulting firms is also a prime area where improvements can be far reaching. Beginning the D&B process with a design competition stage would result in increased innovation and creativity.

Sixth Question

The Sixth question seeks to assess the local industry participants' opinion and views on who should take the lead in changing the current practice regarding the dominance of the D.B.B contracting and the need to adopt other project delivery options.

> *"Would the private sector consider taking the lead in experimenting with D&B or should the public sector initiate this change/initiative?"*

The findings suggest that the majority of the respondents consider that any changes to the current climate in local contracting must be sponsored by the government. Although the Saudi private sector is a major contributor and plays a major role in the Saudi construction industry, the pertinent literature review in Chapter Two confirmed that the Saudi public sector was, and still is, the main contributor to the Saudi construction industry. The government must be at the forefront to eliminate the impediments against the use of the D&B project procurement option. The findings reveal that the role of the government as the driving force behind the success of the D&B project procurement strategy is lagging. Since the work of (Alhazmi and McCaffer 2000) there appears to be no sufficient effort to explore the need for another project procurement strategy other than the traditional D.B.B option. The government and the professional institutes have not effectively performed in educating the public-at-large and have not set good examples. The findings suggest the following improvements:

1. Amend the current contacting arrangements which are based on the D.B.B to allow for D&B bidding and award.
2. Sponsor research and investigation to prepare D&B project procurement guidelines and procedures that would help Saudi construction stakeholders understand the appropriateness and application of D&B contracting option.
3. Improve the design and construction review and approval process in order to facilitate the phased approval of D&B projects.
4. Promote partnering on long term relationships and especially for small and medium size D&B firms.

8.4 The Proposed Improvements

The local construction industry stakeholders are divided or undecided on the benefits of D&B and its appropriateness. The lack of a common understanding, coupled with

the limited available information about D&B project procurement, is depriving the Saudi construction industry of several advantages and potential benefits, especially during boom times. Ten impediments to the adoption of the D&B project procurement options were identified. The proposed solutions were the following:

8.4.1 Increase the Knowledge and Understanding of the D&B principles.

The most significant impediment is the obvious lack of understanding regarding the principles and contractual arrangements of D&B project strategy application. It is also the root cause for the lack of trained and experienced D&B professionals and the absence of small and medium size D&B contracting firms. Few clients know how to accurately prepare the D&B design criteria, performance specifications, or sufficient bidding documents. The proposed improvements include:

- The need for a joint effort led by the local engineering committee, local universities, and professional institutes to increase the level of awareness regarding D&B option.
- The need to host conferences, and focused research to raise the level of understanding of the local industry stakeholders regarding the D&B project procurement option.
- Investment in training staff or obtaining experienced staff in procuring D&B projects, gain knowledge and experience, are areas where the Saudi construction industry must consider.
- Appointing an independent consulting firm on a project to prepare and manage the RFP scopes of work documents. This firm can also define the boundaries of the D&B work packages in terms of their priorities and site needs.
- Inviting the government to sponsor research, case studies research and benchmarking of the application of this project delivery option will provide insight into developing a strategy for wide spread adoption of the D&B option.

8.4.2 Cultural Impediments.

This impediment is based on a misconception that D&B contractors take advantage of their new role. They are thought to use shorten schedule requirements as an excuse to deliver a lower quality project. Many clients believe that consultants and contractors

must always be separated to secure the client's interest. The proposed improvements include:

- Establishing long term relationships or partnering arrangements between consulting and contracting firms that will help remove these cultural barriers.
- Contracting firms must treat the consulting firms as partners and engage them in all major decisions (commercial and technical) throughout the project. Consultants must feel that their opinion is respected. They also must work to meet the project's budget and schedule.
- Establishing a direct dialogue and transparency between the clients and D&B firms while preparing the project cost.
- Encourage D&B clients to nominate their D&B consultants. As a start, this solution assures the D&B clients that the quality of work will be maintained.
- Risks shall be shared and given to the party best capable to handle them.
- Eliminating D&B contract clauses that are biased and adversarial. Encouraging fair and balanced sharing of risks and giving incentives for quality work and early completion.

8.4.3 Slow Regulatory Procedures and the Absence of Phased Permits.

There are many obstacles to obtaining planning and building approvals from the local authorities expediously and in a phased manner. Fast, "turn around" of phased permits is critical to the success of D&B projects. This was confirmed by seventy three percent (73%) of the contracting firms and fifty percent (50%) of the government authorities' clients. The proposed improvements include:

- Inviting the local authorities in collaboration with the consulting and contracting firms to define a workable set of guidelines and set the rules and procedures for the parties engaged in D&B projects to follow.
- Local authorities are also asked to devise an effective design review system that allows issuing phased approval to facilitate site constructions.
- Absence of clear practical and institutionalized legal framework for the local construction industry stakeholders to follow for procuring D&B projects.

8.4.4 Organizational and Contractual Impediments.

This category covered impediments related to the management and organizational approach needed for procuring D&B projects. Improper planning of the flow of

design information to the construction site is a major impediment. Consulting and contracting firms, as well as, several public sector clients lack the understanding of the need for restructuring and reengineering their organization. They do not realize the requirement of building a design team with proper project management skills to handle D&B projects. It also addressed the lack of fair contractual arrangements between the parties of the D&B contract. The proposed improvements include:

- Assuring that D&B projects have a dedicated experienced and empowered team with a proper project management organizational structure.
- Reliance on a competent project manager (PM) who will forecast the resources required, control expenditure of man-hours and monitor progress of work against project objectives, and measure actual performance and propose remedy plans.
- Establishing D&B contracts that are fair to all parties to the contract. The parties must agree mutually fair contract clauses with shared risk allocation, clear duties and responsibilities, clear financial compensation terms and fair dispute resolution procedures.

8.4.5 Fear of Inferior and Unsatisfactory Quality of Works.

The majority of the consulting and contracting firms acknowledged that a major problem they encounter when delivering D&B projects is maintaining an acceptable standard of work. Rework caused by poor coordination or wrong design decisions was found to be inevitable. Poor coordination of design activities caused by the lack of a coordinator and QS was also identified as a significant problem. Proposed improvements include:

- Appointing an independent review team to coordinate all trades and track design errors and report them to the PM for remedial action before they go to tender.
- Successful D&B projects must be published and analyzed. Conducting case studies and publishing completed D&B projects will improve the perception of D&B option.
- Starting the D&B process with a design competition stage would encourage D&B firms to innovate.
- Pre-qualifying D&B contracting firms shall be based on value system and not just the low price.

8.4.6 The Current Inappropriate Process of Selecting and Awarding the D&B Projects.

This category of impediments was referred to by consulting firms, contracting firms, the real estate market evaluators, and insurance firms. The current practice of selecting D&B contractors is solely on the basis of lowest cost. Selecting a contractor could be traced to family relationships (Ragheb, 2005). The prequalification criteria do not always recognize the reputation, experience, and the financial health of the D&B contractors. The selection process should be based on a two-stage assessment. Technical and financial factors must both be considered. Proposed improvements include:

- The use of two-stage prequalification process for D&B is a "must". The selection criteria should not be based solely on lower cost. Rather, the selection should be on experience, reputation, knowledge, track record, and quality of work performed.
- The use of fairer contract forms and a technical and commercial prequalification process.
- Partnering with the supply chain to choose the contractors and suppliers who prove to be reliable and offer certainty of delivery.

8.4.7 Lack of Available Medium and Small Size D&B Contracting Firms.

Many potential D&B projects are cancelled due to the unavailability of medium size D&B firms. Because D&B projects require specially trained resources, higher costs during the bidding stage, and specific bonding and insurance arrangements, the local construction industry has a very limited number of experienced and capable small and medium size D&B firms. Proposed improvements included:

- This program should be led by the government to encourage and invest in the medium size firms to win D&B projects.
- Providing actual successful examples will encourage medium size firms to partner to procure D&B projects.
- D&B clients must compensate unsuccessful D&B bidders a portion of the costs that they incur in preparing the D&B proposal. Giving a stipend would encourage many D&B firms to consider embarking on D&B projects.

8.4.8 The Perceived Risk of no Cost Certainty, Delays, Litigious Attitude that often Leads to Adversarial Relationships.

Cost control was the next most frequently cited reason for using D&B particularly by contracting firms, developers and public sector clients. These clients wish to minimize the extent and impact of change orders on project costs. The results indicated with an overwhelming majority that fear of inferior quality, cost overruns, uneconomical design assumptions and expected claims are the main reasons that deter clients from choosing D&B option. The proposed improvements include:

- The appointment of an independent QA/QC and coordinator team to audit the design and contract documents before they go out to site. This is a measure to control errors and minimize their negative impact.
- Loss of financial control, spiraling cost of repair, and rework were found as an area where the role of the QS is crucial to control the project's cost plan.
- When warranties are included as a part of the contract, the emphasis on project quality takes on even more significance due to the added cost exposure of the project delivery team.
- The dedicated PM team must devise a program with a sufficient buffer to absorb any slippage in program due to a subcontractor's failure to perform to perform.

8.4.9 Government Contract Documents are Based on Procuring D.B.B Option.

The industry contracting arrangements were found to be at the root cause of the problems. The current public sector design and construction contracts are based on the traditional D.B.B. Moreover, the current contracting climate is unfriendly due to the lack of trust between clients and contractors in one hand and consultants and contractors in the other. More focused dialogue and education are needed which should be led by the government. The proposed improvements include:

- The government is invited to properly define the principles and procedures of the D&B contracting, regulate its application and implementation, and set an example by procuring projects along this path.
- Current design and construction contracts which are based on the D.B.B need to be modified to allow for procuring projects along the D&B option.
- The government and the local engineering professional bodies are invited to spread the knowledge about this option through seminars, benchmarking,

education, and most of all, presentation of real examples showing the advantages of this technique and also showing the problem areas to be avoided.

8.4.10 The Missing Role of the Government in Taking the Lead for Exploring the Benefits of the D&B Project Procurement Strategy.

The role of the government as the driving force behind the success of this technique is lagging. The government and the professional institutes are not effectively educating the public at large and setting good examples. The proposed improvements include:

- The government must define the principles and guidelines of the D&B option.
- Sponsor pertinent conferences, seminars and educational programs and spread knowledge by providing examples to the public at large.
- Public agencies are recommended to develop a system that will permit the issue of partial building permits for incomplete construction documents.

8.5 Conclusions and Recommendations

The Saudi construction industry is undecided about the implementation of the D&B project procurement strategy. The results of the surveys showed that the industry is divided with almost 60% of the consulting firms are unwilling to enter into a D&B contract unless certain reforms are made. The interviews with the consulting firms' managers showed that consultants blame clients who are unaware of the principles of D&B and the effects on the project cost and time. However, the question remains regarding who will teach those clients the advantages of D&B and, will the clients be satisfied by listening and seeing published material only?. Certainly not, clients want to see tangible examples and expect to be taught with example of successfully built projects before they change their attitude. Local industry clients, consultants, and contractors are not aware of the principles of this delivery method. They apply their own interpretation and amendments to their D&B contract clauses. This is causing adversarial relationships, conflicts and indirectly making D&B firms seek other means of delivering reduced design work to avoid incurring additional costs.

The government, on the other hand, is doing little to keep pace with the required development and improvements to the current contracting climate. The government should set an example by providing necessary educational opportunities. They need to showcase real life examples to the public at large, contractors and consulting firms to demonstrate the successful implementation of D&B projects.

More educational programs are required to teach the clients the true benefits of D&B project procurement option. There is a need to define and analyze the draw backs of the D&B option. The practice of setting unrealistic deadlines and imposing all types of risks on the D&B contractors must cease. Moreover, the results of the KAUST university case study illustrated that D&B option proved to be the answer for the client's rushed program and quality standards. Despite the cost overruns, the KAUST client was generally satisfied with the outcome of the project in terms of quality and schedule. The above findings showed that, contrary to what many concerned professionals may think, D&B option must be planned for from the start. The level of risks and uncertainties is much higher if proper planning does not occur. Lack of planning causes a chain reaction that affects all work packages.

8.5.1 The Recommendations to the Industry Clients, Policy Makers and Industry Stakeholders at Large.

The following measures are recommended to be considered by D&B clients and the Saudi construction industry stakeholders. Table 8.1 presents further action plan items.

- More careful selection of projects appropriate for D&B.
- Better definition of the design requirements and creation of more accurate bidding documents and guidelines.
- Selection of the D&B consortium on a BEST_VALUE rather than a low bid basis.
- D&B contractors must have a strict QA/QC plans to monitor quality of work.
- Reassess the project program on an ongoing basis as the project moves through the D&B process.
- D&B is a continually evolving concept in which improvements must be incorporated with the completion of every job.

Table 8.1 Recommended Action Items to be Considered by the Saudi Construction Industry Stakeholders.

Guidelines	Future Actions
• There is no clear industry project procurement system or guidelines to define projects appropriate for D&B procurement. • The use of performance criteria is not clear in the D&B process.	• Define the D&B procurement guidelines to assist the local industry choose the appropriate project procurement option. • Encourage the use of performance specification to promote innovation and creativity.
Project selection	**Consultants**

• Not all projects are suited for D&B strategy approach.	• Consultants must advise their clients of the appropriate procurement option to follow. The procurement option selection is to be impartial.
Project Management	**All D&B Clients**
• D&B mandates the allocation of a dedicated project team for the entire duration of project. • Recognize criticality of schedule. • Establish meaningful incentives in the D&B contract. • Establish and maintain open communication channels including regular progress meetings.	• This team will coordinate the design and construction activities and ensure proper coordination of design and construction works. • Setting realistic target dates for D&B projects is essential. This will foster trust and collaborative attitude between all parties to the contract. • This will create a better working environment among the project team. • Direct communication will remove obstacles and bring problems to the surface. This will facilitate cooperative working relationship.
Level of Design and Engineering Documents	**All D&B Clients**
• Develop the RFP documents in a manner not to stifle D&B contractor's creativity and innovation. • Use Two-Stage value system to pre-qualify and award D&B projects. Award is based on low cost basis.	• Carefully consider the appropriate level of design required prior to letting the D&B contract. Over prescribing design details or construction technique may stifle potential innovation. • Use of Two- Stage value system will promote D&B contracting since it removes subjectivity and provides incentives to clients to have the appropriate D&B firms.
Contract language and Definition	**All D&B Clients**
• To ensure that clients receive the expected product within budget, clear and concise performance specifications are essential to the success of D&B contract. • Allocate risks where they are best managed. • Develop design and construction contracts for D&B project procurement option.	• Standardize contract language for D&B project procurement including general and project specific requirements. This will remove many uncertainties and create trust. • Risk must be management by the party best suited to handle it. • Refinement of D&B contract language is a continuous process based on feed back from the construction industry, consultants, contractors and public and private sectors.
QA/QC	**All D&B Clients/D&B Firms**
• Better define QC/QA procedures and who provides them.	• Clients and D&B firms must conduct regular workshops to refine the delivery processes. Continued refinement of

	QA/QC plan will provide better quality.
Change Orders	**All D&B Clients**
• Change orders are expected and should be fair. Develop a mechanism to assess variation orders.	• Fair contract clauses must be defined to evaluate each change order. Establish contingency funding sources for any unforeseen changes required in project design and construction.
Owner Participation	**All D&B Clients**
• Reduce level of preliminary engineering and transfer this work to D&B contractors. • Compensate unsuccessful D&B bidders.	• This will encourage the D&B contractor to innovate and be more creative. • Use of stipend to offset costs of the preliminary design for successful proposers.
Project Selection	**Public Sector/Government**
• Improved guidelines for when to use utilize innovative contracting methods.	• Establish partnership arrangements with local D&B contractors, supply chain, and consulting engineers.
Insurance Premiums	**All D&B Clients/D&B Firms**
• Insurance firms require clear and accurate scope of work and the liabilities covered by each party.	• Move all responsibilities for the project decisions, quality and engineering to the contractor who would hold a comprehensive warranty to cover workmanship repairs and defects.

8.6 The Proposed Framework

The analysis and interpretation of the findings has led to the development of a working conceptual framework. This framework can be referred to as a guide for the Saudi construction industry clients for deciding how to implement each phase of the D&B option. This frame work, shown in figure 7.1, is comprised of six levels. Each level illustrates in a flow chart representation of the tasks needed to progress the project from one level to the next. The responsibilities associated with each task are explained. The potential D&B clients can refer to this model to understand the requirements of each phase along with the responsibilities and the process of selecting a competent D&B firm.

8.7 Limitations and Difficulties Encountered

The author encountered a number of difficulties while researching this topic. First, the subject of D&B project procurement strategy has not been studied in details by many Saudi and non-Saudi scholars. Benchmarking and comparing several studies to triangulate findings and measuring performance and trends were difficult. Secondly,

difficulties were encountered during the surveys and interviews. Some interviews had to be completed over three visits. Others were delayed until after the respondent had time to check his data and confirms the responses. This process was important for the reliability of the responses, but was a burden on completing the research. There are few locally accepted scientific journals and periodicals that can be used as a source for secondary data. The local construction industry does not publish sufficient information regarding the projects that are awarded and the basis of their contractual terms. Most of this data used in this study was sourced from abroad. Additionally, certain financial data related to the details of the variation orders, turnover and profit margins was not provided by some managers due to reasons of confidentiality. Finally, some consulting firms did not accept the invitation to participate in the survey. Their views and results would have been beneficial to the research.

8.8 Recommendations for Areas of Future Research

D&B project procurement strategy will certainly continue to exist for economical and social reasons. The review of literature exposed areas where further research is needed. These include the following topics:

- There is a need to develop guidelines to teach the local public the principles of the D&B project delivery option, to benchmark, and to measure the success levels of projects procured along the D&B procurement option.
- The means to amend the current contractual form of agreement is needed to allow for the introduction of the D&B option.
- A study aimed at defining the increased conflicts under D&B contracting and an analysis of the tools and systems that must be in place to resolve them.
- The examination of bringing consulting and contracting firms closer together to form partnering arrangements on a long terms basis to eliminate cultural barriers.
- Study the measures that the government can take to facilitate the phased approval of D&B projects.
- Identification of user friendly project procurement selection system models that can be generated by the local industry for the use of clients interested in procuring their projects along the D&B option.

8.9 Contribution

The above findings bridge the gap between what is currently known and missing about this problem. In addition, the findings extend prior studies to explain the reluctance to the use of D&B option and develop solutions, answers, and concepts that are grounded in the responses of the industry stakeholders.

This will benefit students and other researchers as was pointed out earlier. This research has value beyond the declared question. It directs the local construction industry students to explore other project procurement delivery options. Other industry participants concerned with finding new ways of thinking about design and build also might find this research project worthwhile. Industry participants and legislative bodies from all disciplines serving in various sectors of the construction industry will find this research useful. Especially those who are involved in the vital decision making processes for planning and awarding projects. They will gain an understanding of the practiced paradigm and the potentials of exploring other project delivery options.

Scholars interested in examining the practice of D/B in Saudi Arabia will find sections of this research useful for broadening their understanding of the cultural and environmental dimensions in the Saudi construction industry.

8.10 Final Statement

In an age of multiple project delivery approaches, professionals must be knowledgeable of all the delivery options and must become "project delivery system impartial". The quality performance of the project can be attributed to the right and effective procurement choice at the start of the project. Clients will continue to be looking for economic, practical and durable buildings. D&B clients must also realize that rushing into unplanned and un-organized procurement strategies will not lead to saving time and costs. Proper planning and understanding the suitability of D&B option for specific projects are the key factors for the success of D&B option.

If properly managed, D&B procurement strategy will cut wasted time, energy and costs from the entire building process. The process of saving time and cost will create a teamwork environment that yields higher and better design quality and construction performance. The Saudi perception of D&B project procurement option can only be described as going through a state of confusion and experimentation. With the lack of

a understanding of this process and how it functions, developers and investors, seem to miss other opportunities and prerequisites for this process to succeed. Consultants are ethically and professionally bound to expedite the design and construction process in the most efficient manner, regardless of the choice of procurement path.

The findings also suggest that the long term future of D&B option is assured, simply because of its economic implications. Consultants and contractors have to learn how to cope with D&B delivery option. The local legislative authorities must define and control the proper application of this project delivery option. Once these goals achieve the desired results, true and lasting benefits will occur.

In summary, there is occurring in Saudi Arabia a surge in construction as the country prepares a transition away from a fossil fuel based economy. While there is always the desire to find better, faster and more economical ways to construct projects, a severely critical need has developed in the Kingdom. It is certain that the traditional Design Bid Build will not accomplish the vast number of projects in the offing to meet Saudi Arabia's demands. As a consequence, this thesis has examined the construction industry and found that D&B construction is an answer. It is currently achieving results as seen in projects such as KAUST. The business activities of the largest construction entities in the Kingdom show the reality of the situation. The greater portion of their work is not taking advantage of the benefits of D&B while all indications would advise the opposite. More volume would be accomplished to meet the market demands if projects were completed with D&B techniques. D&B in the right hands practicing with sophistication will create high design that is well constructed within a shorter time resulting in lower costs. Obviously, something is preventing or encumbering this from happening.

This study reveals that D&B Project procurement strategy provides a "road map" for the Saudi construction industry to improve and assist the Kingdom in its transformation for the future.

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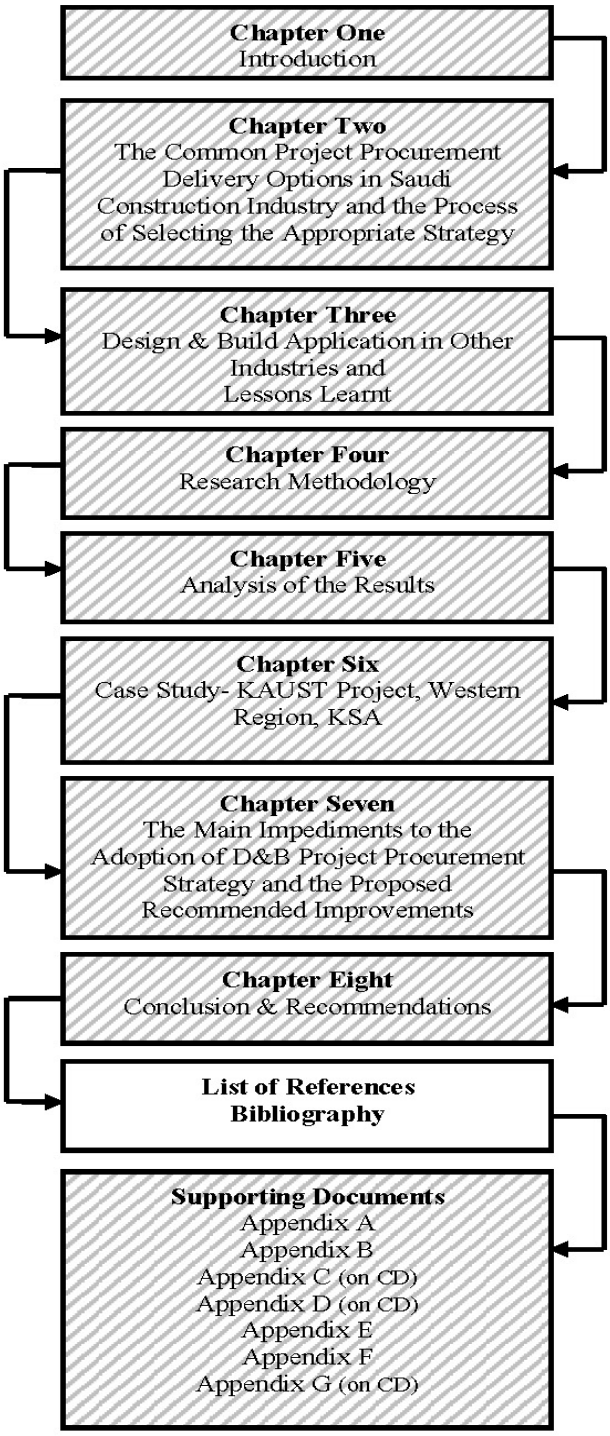

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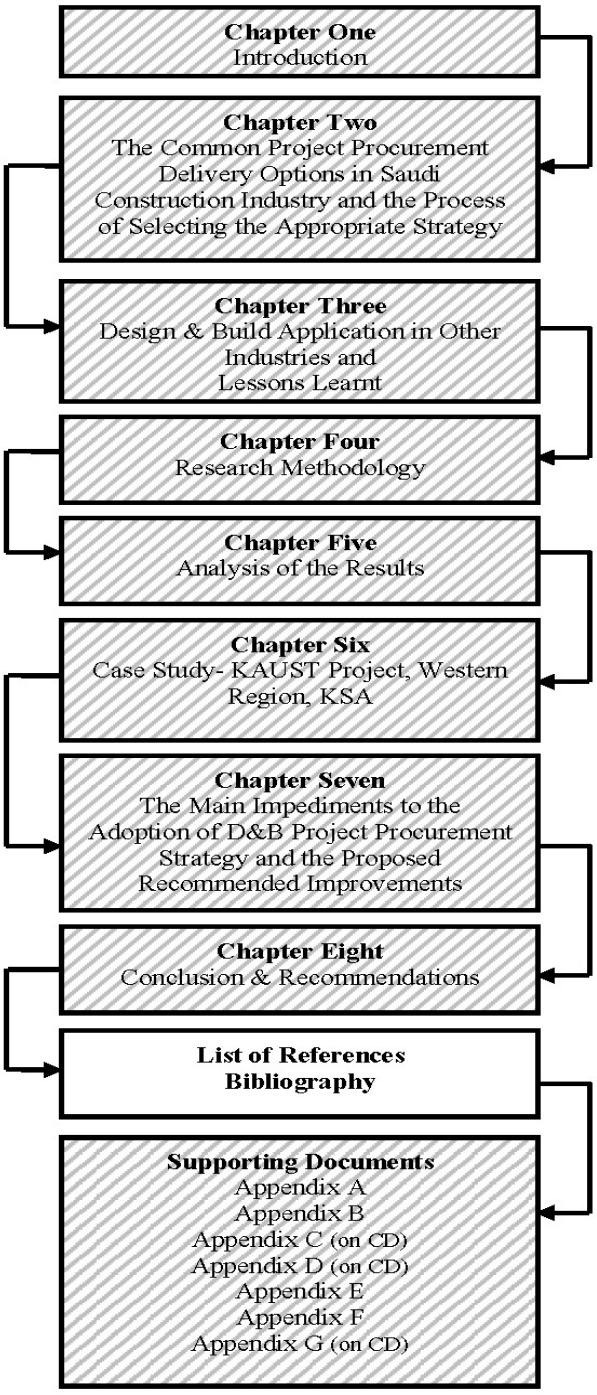

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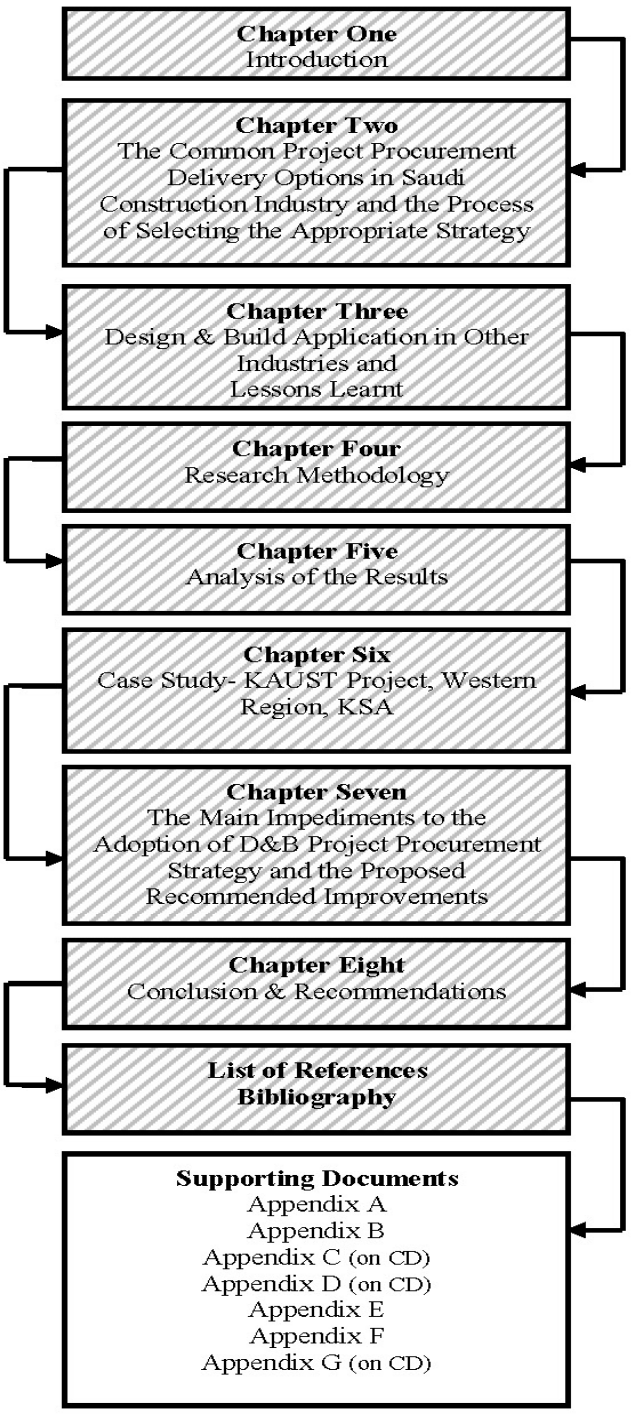
Supporting Documents
Appendices A,B,C,D,E,F,G.



APPENDIX (A)
THE QUESTIONNAIRE SURVEY (CONTRACTING & CONSULTING FIRMS)

Questionnaire Survey

INSTRUCTION: Please mark the answer that mostly reflects your reasons for decisions on construction projects. (Respondent's information will remain anonymous and the data will be used for educational purpose only).

Section I: Respondent's General Information

Please indicate your nationality (Please tick ✓ the appropriate answer)

Group :	E
Interview No. :	1 of 35 -------
Name (Optional)	-------
Company Name:	--------
Discipline : EL	Electrical Engineering
Telephone No.:	
Date :	----------
Time Start:	00: 00 hr
Time End:	00: 00 hr
Facsimile:	
E-mail Address:	

Please indicate your nationality (Please tick ✓ the appropriate answer)

1.	2.	3.	4.	5.	6.	7.	8.
Saudi	Gulf States	Arab	European	North American	Asian	African	Others
☐	☐	☐	☐	☐	☐	☐	☐

Section II: Consultant's Work Information (Please tick ✓ the appropriate answer)

2.1 What is the average number of professional staff that is present at your firm?

1.	2.	3.	4.	5.
30 – 40	40 – 80	80 – 120	120 – 180	>250
☐	☐	☐	☐	☐

2.2 What is the yearly average turnover that your firm normally generates in $ US Dollar (optional)?

1.	2.	3.	4.
Less than 20 million	25 million	40 million	> 50 million
☐	☐	☐	☐

2.3 What is the number of medium to large size projects that your firm is awarded per annum; along the traditional project delivery system?

		0	1	2	3	4	or more
1. Medium size project	= $ 20 - 50 million construction cost	☐	☐	☐	☐	☐	☐
2. Large size project	= $ 100 - 200 million construction cost	☐	☐	☐	☐	☐	☐
3. Very Large size project	= $ 210 - 500 million construction cost	☐	☐	☐	☐	☐	☐
4. Mega project	> $ 500 million construction cost	☐	☐	☐	☐	☐	☐

Section III: Knowledge and Awareness of Design and Build (Please tick ✓ the appropriate answer)

3.1 Are you aware about Design and Build (D/B) contracting?

1.	Well Aware	2.	Aware	3.	Vaguely Aware	4.	Not Aware

3.2 Does your firm provide Design and Build project delivery options to your Client? If the answer is no please go to section IV question 4.3

1. ☐ Yes
2. ☐ No
3. ☐ Only if the price is sufficient
4. ☐ Only if required by repeated Clients
5. ☐ For attractive projects
6. ☐ Other (please specify below)

3.3 What is the number of medium to large size D/B projects that your firm is generally awarded per annum?

		0	1	2	3	4	or more
1. Medium size project	= $ 20 - 50 million construction cost	☐	☐	☐	☐	☐	☐
2. Large size project	= $ 100 – 200 million construction cost	☐	☐	☐	☐	☐	☐
3. Very Large size project	= $ 210 - 500 million construction cost	☐	☐	☐	☐	☐	☐
4. Mega project	> $ 500 million construction cost	0 ☐	1	2 ☐	3 ☐	4 ☐	or more ☐

3.4 Please specify since when has your firm been involved and working with Design and Build projects delivery option?

1.	Less than 5 years	2.	5 – 10 years	3.	10 – 15 years	4.	Over 15 years
	☐		☐		☐		☐

3.5 What are the types of projects that you know are being procured along Design and Build option? Please rank the frequency of each, in a priority order.

	High		Priority						*Low*
1. Commercial	1	2	3	4	5	6	7	8	9
2. Residential	1	2	3	4	5	6	7	8	9
3. Office	1	2	3	4	5	6	7	8	9
4. Education	1	2	3	4	5	6	7	8	9
5. Medical	1	2	3	4	5	6	7	8	9
6. Leisure	1	2	3	4	5	6	7	8	9
7. Religious	1	2	3	4	5	6	7	8	9
8. Industrial	1	2	3	4	5	6	7	8	9
9. Others, Institutional Military Aviation, (please specify)	1	2	3	4	5	6	7	8	9

3.6 What are the backgrounds of your clients that request projects be procured on Design and Build option ? Please rank in priority order which client asks for D/B project.

	High		Priority				*Low*
1. Investors	1	2	3	4	5	6	7
2. Private client	1	2	3	4	5	6	7
3. Government	1	2	3	4	5	6	7
4. Semi Government	1	2	3	4	5	6	7
5. Developers	1	2	3	4	5	6	7
6. Consultants	1	2	3	4	5	6	7
7. Others, (please specify below)	1	2	3	4	5	6	7

_____

_

Section IV: The Local Operating Environment and Objectives of Design and Build Projects (Please tick ✓ the appropriate answer)

4.1 At what stage of the project life cycle process do your clients generally invite you to Design and Build projects? Please rank in a priority order.

	High ← Priority → *Low*					
1. Following the preparation of (RFP) stage	1	2	3	4	5	6
2. After the marketing / feasibility study	1	2	3	4	5	6
3. After the prequalification stage	1	2	3	4	5	6
4. After the preliminary design stage	1	2	3	4	5	6
5. After design development stage	1	2	3	4	5	6
6. Other, (please specify)	1	2	3	4	5	6

_____

4.2 Have you encountered any problem when working on Design and Build project that discourage you from accepting new Design and Build contracts?

	High	Priority →			*Low*
1. Yes	1	2	3	4	5
2. Occasionally	1	2	3	4	5
3. No	1	2	3	4	5
4. In specific circumstances	1	2	3	4	5
5. Other, (please specify)	1	2	3	4	5

_____

–

4.3 Do you think that your clients are aware of Design and Build accelerated design programs?

1. Fully aware ☐	2. Fairly aware ☐	3. Neutral ☐	4. Vaguely aware ☐	5. Unaware ☐

4.4 Do you think that your clients are aware of, and in agreement with the expected number of design changes associated with D/B projects and the impact of this on the project cost and time?

1. Fully aware ☐	2. Fairly aware ☐	3. Neutral ☐	4. Vaguely aware ☐	5. Unaware ☐

4.5 Why do your clients choose Design and Build option? Please indicate in a priority order the objectives of the clients choosing D/B option.

	High	Priority							*Low*
1. Market place advantage	1	2	3	4	5	6	7	8	9
2. Earlier revenue	1	2	3	4	5	6	7	8	9
3. For renovation project	1	2	3	4	5	6	7	8	9
4. Rushed project	1	2	3	4	5	6	7	8	9
5. Complexity of the project	1	2	3	4	5	6	7	8	9
6. Reduced Cost	1	2	3	4	5	6	7	8	9
7. Better product	1	2	3	4	5	6	7	8	9
8. Dealing with one entity	1	2	3	4	5	6	7	8	9
9. Other, (Please Specify)	1	2	3	4	5	6	7	8	9

Section V: Observations and Recommendations for the Future (Please tick ✓ the appropriate answer) indicate in priority order.

5.1 What are the nature of impediments to the application of Design and Build contracting?

	High	Priority					*Low*
1. General Knowledge	1	2	3	4	5	6	7
2. Cultural	1	2	3	4	5	6	7
3. Political	1	2	3	4	5	6	7
4. Contractual	1	2	3	4	5	6	7
5. Regulatory	1	2	3	4	5	6	7
6. Liability insurance	1	2	3	4	5	6	7
7. Others, (please specify below)	1	2	3	4	5	6	7

5.2 Whether you have in the past or not, at what stage would your firm accept to be part of the Design and Build delivery team? Please indicate in a priority order.

	High	Priority						*Low*
1. Only if we know the client well	1	2	3	4	5	6	7	8
2. Only if we select the Designer	1	2	3	4	5	6	7	8
3. Subject to agreement on contract conditions, schedule and budget.	1	2	3	4	5	6	7	8
4. Only if we jointly prepare the contract with the designer.	1	2	3	4	5	6	7	8
5. Subject to project type	1	2	3	4	5	6	7	8
6. Only if there is an experienced client representative on site.	1	2	3	4	5	6	7	8
7. If the scope and client requirements are clear	1	2	3	4	5	6	7	8
8. Other, (please specify)	1	2	3	4	5	6	7	8

5.3 What are the main problems that your firm encounters when asked to deliver the projects along the Design and Build option? Please indicate in a priority order which of the following variables present more problems.

		High ← Priority → *Low*										
1.	Lack of financial compensation	1	2	3	4	5	6	7	8	9	10	11
2.	Continuous planning to cope with site activities	1	2	3	4	5	6	7	8	9	10	11
3.	Maintaining an acceptable standard of design work.	1	2	3	4	5	6	7	8	9	10	11
4.	Coordination problems with engineering disciplines.	1	2	3	4	5	6	7	8	9	10	11
5.	Slow decision making by the client.	1	2	3	4	5	6	7	8	9	10	11
6.	Always avoiding reworks and cost overrun.	1	2	3	4	5	6	7	8	9	10	11
7.	Having to shield the continuous designer's changes.	1	2	3	4	5	6	7	8	9	10	11
8.	Having to allow over estimated space requirements.	1	2	3	4	5	6	7	8	9	10	11
9.	Lack of clear client requirements.	1	2	3	4	5	6	7	8	9	10	11
10.	Lack of trained professional resources	1	2	3	4	5	6	7	8	9	10	11
11.	Insurance liabilities, contractual responsibilities, risks distribution are not clear.	1	2	3	4	5	6	7	8	9	10	11

5.4 What makes the traditional project delivery system an attractive choice for you? Please indicate in a priority order.

		High ← Priority → *Low*									
1.	Clear comprehensive client brief.	1	2	3	4	5	6	7	8	9	10
2.	Lack of many qualified Design and Build firms.	1	2	3	4	5	6	7	8	9	10
3.	Many consultants prefer not to work for contractors.	1	2	3	4	5	6	7	8	9	10
4.	Contractual Responsibilities /duties /Obligation / risk distribution are clear.	1	2	3	4	5	6	7	8	9	10
5.	Familiarity with the traditional system compared with D/B option.	1	2	3	4	5	6	7	8	9	10
6.	Insurance, liability, and contractual clauses and regulations are clear.	1	2	3	4	5	6	7	8	9	10
7.	Some clients do not feel comfortable dealing directly with contractors and prefer dealing with consultant.	1	2	3	4	5	6	7	8	9	10
8.	Design document checked systematically for coordination, errors and compliance to specifications.	1	2	3	4	5	6	7	8	9	10
9.	Less coordination problems compared to other project delivery systems.	1	2	3	4	5	6	7	8	9	10
10.	No pressure from contractors, to design differently to meet site demands.	1	2	3	4	5	6	7	8	9	10

5.5 Please rank the following measures in order of priority that in your opinion will help D/B firms resolve some of D/B issues and make D/ B project delivery system more attractive.

		High				Priority						*Low*
1.	Introduction of revised building regulations and increase public awareness about Design and Build option.	1	2	3	4	5	6	7	8	9	10	11
2.	Set through planning the priorities of the work sequences and work quantities with agreement on site needs.	1	2	3	4	5	6	7	8	9	10	11
3.	Having shared understanding of the scope of works.	1	2	3	4	5	6	7	8	9	10	11
4.	Having an acceptable completion date with achievable milestone.	1	2	3	4	5	6	7	8	9	10	11
5.	Having an experienced client representative and an experienced independent cost engineer on the project.	1	2	3	4	5	6	7	8	9	10	11
6.	Agree contractual compensation changes formula.	1	2	3	4	5	6	7	8	9	10	11
7.	Agree contractual clauses, for all parties to the contract based on win-win approach.	1	2	3	4	5	6	7	8	9	10	11
8.	Having in house experience in procuring Design and Build projects.	1	2	3	4	5	6	7	8	9	10	11
9.	Involve the client in regular decision making meeting.	1	2	3	4	5	6	7	8	9	10	11
10.	Be involved on the project from initiation to hand over.	1	2	3	4	5	6	7	8	9	10	11
11.	Availability of qualified D/B consultant.	1	2	3	4	5	6	7	8	9	10	11

5.6 Would you recommend the design and Build project delivery option to your current and new Clients? Please indicate answers in priority order.

		High			Priority			*Low*
1.	Yes, (Please say why)	1	2	3	4	5	6	7
2.	No, (Please say why)	1	2	3	4	5	6	7
3.	Subject to project complexity	1	2	3	4	5	6	7
4.	Subject to client understanding of fast track and Design and Build process.	1	2	3	4	5	6	7
5.	Only if contractually requested	1	2	3	4	5	6	7
6.	Subject to availability of experienced Design and Build Consultants.	1	2	3	4	5	6	7
7.	Others, (Please specify)	1	2	3	4	5	6	7

_____

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5.7 Do you think the Design and Build delivery option may become a choice for the industry in the future?

1. ☐ Only after major changes in the industry practice towards collaboration
2. ☐ Only in boom times
3. ☐ No
4. ☐ Dependents on the Clients understanding of D/B
5. ☐ Yes,
6. ☐ Yes, through the public sector
7. ☐ Not sure
8. ☐ Yes, through the private sector
9. ☐ Other (please specify)

_____
_

Section VI: Open–Ended question

6.1 In your opinion, what would make Design and Build contracting an attractive project delivery option? And how you compare Design and Build option with the traditional option?

	Results
Conclusion	

APPENDIX (E)

CASE STUDY INTERVIEWS
SEMI-STRUCTURED QUESTIONS
ADDRESSED AT :

1. **The Client Representatives**
2. **The Consultant Representatives**
3. **The Contractor Representatives**

INTERVIEW FORM

Name : _____
Contact Tel. No#. : _____
Date / Time : _____
References : _____
Type of Interview : _____
Party : (Client), (Consultant), (Contractor)

Questions Asked **Part I, Questions to the Client**

1.1 Knowledge and Experience with Design and Build (D/B) project delivery.

Aware		Not Aware		Vaguely Aware	

1.2 Your firm's/institute's experience with D/ B project delivery option.

Aware		Not Aware		Vaguely Aware	

1.3 Did this D/B project achieve the contract budget targets?

Yes		No		Not sure	

1.4 Did this D/B project achieve the contract schedule?

Yes		No		Not sure	

1.5 Did this D/B project achieve the stipulated quality standards?

Yes		No		Not sure	

1.6 Did you use an industry standard project procurement selection system or model to choose the optimum project delivery system for your projects?

Yes				No	

1.7 Why did you choose the D/B project delivery option for this project?

Speed	Lower Cost	Certainty of Price
Better Quality	Government Contractual Laws and Procedures	Better Management of Risk
Familiarity With This Option	Certainty of Delivery	

1.8 Did you use a standard D/B form of contract to procure this D/B projects? Or did you develop a bespoke form of contract?

Used a Standard Contract Form	Developed a Bespoke Contract Form	Not Sure

1.9 Who prepared the scope of work for this D/B project?

Prepared In- House	Out- Sourced to an Independent firm	Combined, In-House and Independent Effort

1.10 What process do you follow to select the D/B entity for this D/B project?

Two-Stage Prequalification Selection Process.	Lowest Offer is Awarded the Project.	Select D/B Firms Based on Track Record.

1.11 At what stage of the project life cycle did you invite the D/B firms to bid for this D/B project?

Following the Preparation of the RFP Document.	Following The Preparation of the Master plan documents.	Following The Preparation of the Architectural Concept Stage.	Following The Preparation of the Preliminary Architectural Stage.

1.12 Did you encounter problems or delays to obtain the planning and building permits approvals?

Yes		No		Occasionally	

1.13 Were you satisfied with the end result of the project?

Yes		No		Not Sure	

Yes		No		In specific circumstances	

1.14 Would you recommend the adoption of D/B project delivery option for your future projects?

1.15 In your opinion, what were the criteria of success for this D/B project?

_____

1.16 In your opinion, what were the main problem areas for this D/B project?

_____

Part II, Questions to the Consultant

2.1 Knowledge and Experience with Design and Build (D/B) project delivery.

Aware		Not Aware		Vaguely Aware	

2.2 Your firm's/institute's experience with D/ B project delivery option.

Aware		Not Aware		Vaguely Aware	

2.3 Did this D/B project achieve the contract budget targets?

Yes		No		Not sure	

2.4 Did this D/B project achieve the contract schedule?

Yes		No		Not sure	

2.5 Did this D/B project achieve the stipulated quality standards?

Yes		No		Not sure	

2.6 How was the performance of the Client during the PLC?

Very good. Collaborative and proactive. Making timely decision Supportive, met contract payments.	Fair. Showed adequate understanding of scope and approach. Followed the contract requirements.	Not collaborative. Caused delays in responses. Introduced many changes and disruptions to the work.

2.7 How was the performance of the contractor during the PLC?

Very good Collaborative, proactive. Forward looking. Aware of the contractual challenges.	Fair Demonstrated a combination of good and poor performance.	Not collaborative. Unprepared to deliver the project. Lacks sufficient experience and knowledge with D/B project delivery option.

2.8 In your opinion, what were the critical successful targets achieved on schedule/cost/quality?

2.9 In your opinion, what were the major problems encountered in this D/B project which contributed to the delay or increased cost?

Part III, Questions to the Contractor

3.1 Knowledge and Experience with Design and Build (D/B) project delivery.

Aware		Not Aware		Vaguely Aware	

3.2 Your firm's experience with D/ B project delivery option.

Aware		Not Aware		Vaguely Aware	

3.3 Did this D/B project achieve the contract budget targets?

Yes		No		Not sure	

3.4 Did this D/B project achieve the contract schedule?

Yes		No		Not sure	

3.5 Did this D/B project achieve the stipulated quality standards?

Yes		No		Not sure	

3.6 How was the performance of the Client during the PLC?

Very good. Collaborative and proactive. Making timely decision Supportive, met contract payments.	Fair. Showed adequate understanding of scope and approach. Followed the contract requirements.	Not collaborative. Caused delays in responses. Introduced many changes and disruptions to the work. Delayed contractual payments.

3.7 How was the performance of the consultant during the PLC?

Very good Collaborative, Priorities were clear. Responsive, aware of	Fair Aware of the contractual requirements.	Not collaborative. Lacks sufficient experience and knowledge with D/B

the contractual challenges.		project delivery option. Caused many late changes.

3.8 How would you evaluate the performance of the parties – Sub consultants – Sub contractors, suppliers, and manufacturers?

Very good		Fair		Not good	

3.9 Would you recommend the adoption of D/B project delivery option for future projects?

Yes		No		In specific circumstances	

3.10 What were the main factors that contributed to the success of this D/B project?

_____

3.11What were the main problems encountered during the PLC that directly affected the cost, quality and schedule of the project?

_____

3.12 How would you explain your experience with the project? Lesson learned.

_____

END//

APPENDIX (F)

PICTORIAL DOCUMENTATION OF THE SITE CONSTRUCTION DEVELOPMENT FROM START TO HANDING OVER

2007

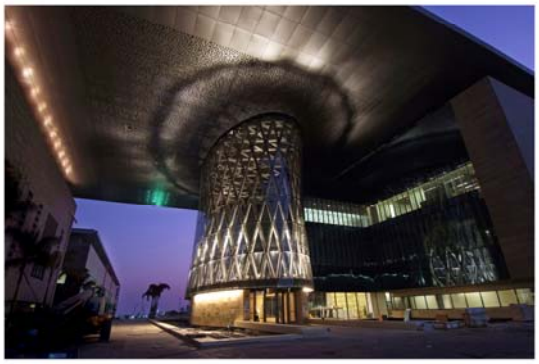
OCTOBER 07

APRIL 08

SEPTEMBER 08 - OCTOBER 08

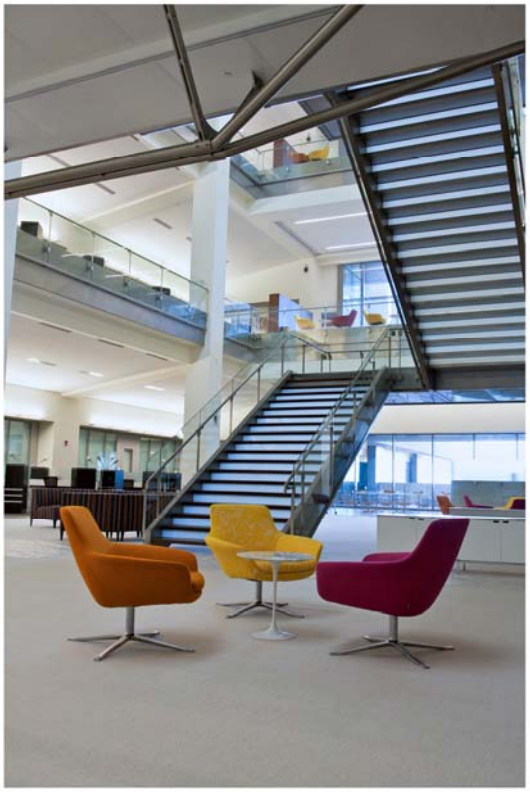
APRIL 09- MAY 09

AUGUST 09- PRESENT



AUGUST 09- PRESENT

PRESENT



PhD

I. S. A. AL SAUDI

2011